COMPARISON OF SOIL SHEAR STRENGTH PARAMETERS AND P-Y CURVES FOR LATERALLY LOADED PILES IN GRANULAR SOIL

by

Zachary Ross McClellan

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STATEMENT OF THESIS APPROVAL

The thesis of **Zachary Ross McClellan**

has been approved by the following supervisory committee members:

Steven Bartlett	, Chair	**12/26/2012** Date Approved
Evert Lawton	, Member	**12/26/2012** Date Approved
Chris Pantelides	, Member	**12/26/2012** Date Approved

and by **Chris Pantelides** , Chair of

the Department of **Civil and Environmental Engineering**

and by Donna M. White, Interim Dean of The Graduate School.

ABSTRACT

This study presents the details of a site specific investigation and drilled shaft foundation study for a site in Tremonton, Utah, which is along PacifiCorp's constructed 345 kV transmission line extending from Ogden, Utah to Downey, Idaho. This study is based off of a three part investigation previously submitted to PacifiCorp, and its objectives to evaluate the shear strength and deformation characteristics of a granular, transitional soil for the proposed construction of laterally loaded drilled shafts.

The primary goals of this research project are as follows: (a) Perform detailed geological and geotechnical investigations in order to define the variability of the shear strength and deformation behavior of the subsurface soils using the various field and laboratory test methods performed on the soils from the transitional material site; (b) identify and compare the strengths and weaknesses of the various test methods and evaluate their applicability to the characterization of the transitional materials at the subject site; (c) evaluate and compare the load vs. deformation (i.e., P-y) curves determined for the design structural loading condition(s) using the shear strength properties obtained from each test method (d) recommend additional studies that will result in improvements to the foundation design in similar subsurface conditions.

The first task undertaken to achieve these objectives was to perform a detailed geological investigation at each site. Surficial geological units were determined for the site, and several types of geological hazards were investigated and analyzed.

Geotechnical investigations were then conducted for the site, according to the predominant types of subsurface materials present. The subsurface materials consist primarily of transitional granular-cohesive soils with significant amounts of gravel and larger size particles.

The results from the geological and geotechnical investigations were used to estimate appropriate engineering parameters for the analysis and design of drilled shaft foundations at the site. The computer program, *LPILE*™ was used for the analyses and designs. Comparisons of the designs were made between the actual foundation constructed at the Tremonton site and those determined using parameters obtained in this research project.

Major recommendations regarding future research and training are summarized as follows: (a) full-scale load tests at the subject site investigated in this research project should be performed to determine the accuracy and reliability of the various methods used for analysis; (b) several additional triaxial compression tests be conducted to validate results determined in this study.

To my family and friends,
for the immeasurable support and encouragement.

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1 INTRODUCTION

In most construction and development projects, geotechnical investigations of the subsurface materials at a given site are performed to provide design engineers with the information needed to perform engineering evaluations and make recommendations to the developer and all other design entities working on the project. In most cases, the shear strength and deformation properties of the subsurface soil are the most important information gathered in the geotechnical investigation, and often the most challenging to determine. Often there can be a high degree of variability in these properties which adds difficulty to the characterization effort.

Each project site is comprised of its own unique geologic history and subsurface profile. The soil profile may remain relatively consistent beneath the site, or it may change drastically depending on the geological depositional environment, nature and age of the deposited soils, their heterogeneity, anisotropy, and other soil and environmental factors. These considerations underscore the need for careful and comprehensive geotechnical investigations as a vital and necessary first step in the design and development process. Geotechnical engineers are responsible for the characterization of subsurface materials which becomes the basis of their subsequent design evaluations and calculations. These calculations require fundamental soil properties (e.g., shear strength, compressibility, permeability, etc.), or use empirical correlations that relate these fundamental properties with the results of index tests (e.g., grain-size distribution analyses, Atterberg limits, etc.). Such index properties are commonly determined from field and laboratory tests and have been correlated with higher quality laboratory testing to estimate the fundamental property of interest. The selection of the combination of tests and methods used in the characterization effort is based on their relative costs, budget constraints, and the expected and/or encountered subsurface soils at the project site. In many cases, the fundamental soil properties are estimated through the use of existing empirical correlations based on previous experience at other sites, which may or may not be applicable to the site under consideration. Also, because site drilling and testing methods are often chosen based on the assumption that the soils are either cohesive or granular in nature, transitional subsurface materials add an additional difficulty factor to the investigation, being that they are neither purely cohesive nor purely granular. The complexity of characterizing transitional subsurface materials increases when considering the possibility of dilative and contractive soils, and determining the subsurface drainage state of those soils.

The type and condition of the field samples determine which methods are selected in the subsequent laboratory test program. The field sampling method(s) and sample quality are a factor of the soil type, drilling methods, and care and quality of the drilling operations. Invariably, sample disturbance resulting from the drilling and sampling operations can moderately to greatly influence the laboratory-determined soil properties. In addition, any natural cementation occurring in the subsurface is often destroyed by most drilling and sampling techniques, which can further impede the accurate characterization of the shear strength and deformation behavior of the soils. Thus, geotechnical investigations can produce significantly varying results, especially when transitional materials are encountered.

Because of their natural variability and the uncertainty associated with many sampling and test methods, a wide range of drilling techniques and testing procedures are often required to fully describe the shear strength and deformational behavior for a site with given foundation loading conditions. This thesis includes a case study of a site-specific investigation performed in transitional material in northern Utah to characterize transitional soil shear strength and deformation behavior under large-diameter drilled shaft loadings. The characterization and design evaluations were performed in order to improve the techniques used by PacifiCorp and its contractors for laterally loaded drilled shaft foundations associated with high-voltage transmission lines. PacifiCorp, which is a regional utility that operates much of the electrical power grid in Utah, funded this research.

This study utilizes data previously provided to PacifiCorp by The University of Utah as part of a three part study (Lawton et al., 2011). The objectives of the study were to compare various methods of field and laboratory testing with each other to evaluate their effectiveness and limitations in defining the subsurface characteristics. This study adds to the previous work and seeks to complete the following objectives:

- Define the variability of the shear strength and deformation behavior of the subsurface soils using the field and laboratory test methods performed on the soils from a transitional material site.
- Compare the results of the shear strength properties determined from each test method.

- Identify and compare the strengths and weaknesses of the various test methods and evaluate their applicability to the characterization of the transitional materials at the subject site.
- Evaluate and compare the load vs. deformation (i.e., *P*-*y*) curves determined for the design structural loading condition(s) using the shear strength properties obtained from each test method.
- Discuss the findings and make general recommendations.

To complete the above objectives, it was first necessary to research existing published documents for comparisons and testing of shear strength properties using various testing methods applicable to transitional soils, and also determination of those properties within the soil profile of the site. This literature review is presented in Chapter 2, and includes information comparing results of shear strength property testing for small and large diameter triaxial compression tests. It also includes a review of analytical methods used to develop *P*-*y* curves from the determined shear strength properties.

The research and work performed for the previous study for PacifiCorp (Lawton et al., 2011), are presented in Chapters 3 through 5. Chapter 3 describes the detailed geological investigation. This investigation utilized available regional geologic maps, reports, and GIS data to provide an overview of the regional and site-specific geology, including the potential geologic hazards. The details of the geotechnical field investigation are presented in Chapter 4. The geotechnical field investigation included completion of sonic drilling, soil sampling using additional drilling and sampling techniques, and in situ testing. First, sonic drilling was used to drill and obtain continuous bulk samples down to the desired depth and standard penetration tests (SPT) were performed concurrently with the drilling advancement. On additional visits to the site, mud rotary drilling and large diameter solid flight augering were utilized. Mud rotary drilling was used to drill down to specific depths to perform pressuremeter testing (PMT). Augering was used to obtain bulk samples for unit weight determinations. Cone penetration testing (CPT) and Becker hammer penetration Tests (BPT) were also performed on separate visits. Chapter 5 presents the details of the laboratory investigation, which includes standard index testing (water content, unit weight, Atterberg limit tests, and grain size analyses). Also, included in Chapter 5 are the details of the large (6 in.) and small (2.8 in.) diameter triaxial compression tests that were performed on the reconstituted bulk samples obtained from the sonic drilling.

Chapter 6 provides details on the data reduction from the field and laboratory tests including data from the pressuremeter tests, triaxial compression tests, cone penetration tests, Becker hammer testing, and standard index testing. Force versus displacement curves are presented as a result of the pressuremeter tests, and shear strength properties including undrained shear strength, and internal peak friction angles are also presented in tabular form. Subsurface profiles are also presented with the information gathered from the field and laboratory testing. The objective of this chapter was to assess the variability of results obtained from the many tests performed.

Chapter 7 compares and discusses the results obtained from the large and small diameter triaxial compression tests performed on reconstituted bulk sample obtained from the field investigation at the subject site. Details are presented on the method where the samples were reconstituted and loaded in the triaxial cell to obtain values of the undrained shear strength and peak internal friction angle of the subsurface material.

Results from each testing method are compared and differences in the results are investigated.

Chapter 8 provides an evaluation of the analytical *P-y* methods used to model the response of the subsurface soil profile to a design horizontal loading as a series of discrete, nonlinear springs placed along the length of the drilled shaft. The computer program *LPILE* (2011), was used for these evaluations, which uses methods based on site-specific full scale load tests for various types of subsurface material and conditions. This study utilized the “stiff clay with no free water” and the “sand (Reese)” soil type options in *LPILE* (2011). Shear strength properties of the subsurface material results from the analyses were based on these methods compared to the P-y curves developed from the PMT results.

Lastly, conclusions and recommendations are provided regarding the comparisons and results of each of these chapters.

2 BACKGROUND AND LITERATURE REVIEW

2.1 Overview

The focus of this study is to compare and evaluate various methods that may be used to estimate shear strength properties and deformation behavior within transitional soils for the application of designing drilled shaft foundations subjected to lateral loads. There are many different field and laboratory methods used in practice to determine these values. However, many of these methods are applicable to either granular or cohesive soil types, but not both. Transitional soils, being neither purely cohesive nor purely granular, tend to exhibit unique behavior with more complex failure conditions under foundation loadings. Therefore, the comparison of the results from the various field and laboratory testing procedures herein will give insight and recommendations regarding methods were a more suitable and reliable for the additional complexity of transitional soils.

2.2 Triaxial Testing

Drained and undrained triaxial compression and triaxial extension tests are common geotechnical laboratory tests used to determine the shear strength characteristics of subsurface material. Reduction of the data from these tests can provide engineers with estimates of the peak drained internal friction angle, ϕ'_p, for drained soils and the undrained shear strength, s_u, for undrained soils. The properties can subsequently be used in the evaluation and design of drilled shafts.

Depending on the type of subsurface materials encountered and the type of samples obtained from the field investigation (e.g., undisturbed or disturbed), undisturbed samples are trimmed to a specified length and diameter, or disturbed samples are reconstituted in a sample mold to the in-situ moisture and density conditions. In most cases, the specimens are trimmed or reconstituted to a diameter of approximately 2.8 in. with a length to diameter ratio of 2 to 2.5. Also, as a general rule, a reconstituted sample will first be passed through a sieve screen so that the soil particles are comprised of those having a diameter less than one-sixth the diameter of the overall sample to be tested. Thus, the soils being tested are then reconstituted with a different composition than that of the in situ material at the site.

For example, Chew and Bharati (2011) carried out triaxial testing on samples for a large, future development off the east coast of Singapore. This investigation explored the question of whether or not the smaller size specimens tested had limitations due to the sample being more homogeneous and uniform in "fabric" and "structure". Therefore, a series of large diameter (200 mm) triaxial compression tests were carried out to be able to compare the results to that of previously tested small diameter (50 mm) triaxial compression tests on the same marine clay. Both samples were stated as being high quality "undisturbed" samples trimmed to the required diameter and height. They also compared the effects of the size of the sampler on the test results. In conclusion, this investigation found that the undrained shear strengths obtained from the larger diameter samples were lower than those obtained from the smaller diameter samples, although both samples were obtained using a large diameter sampler. In addition, the combined effects of the sampler size used in the field investigation and the triaxial testing sample size were even greater. The values of undrained shear strength obtained from the larger diameter samples were 20% to 70% lower than those obtained from the smaller diameter triaxial samples using the smaller diameter sampler. These investigators also concluded that the reduction in shear strength was due to the presence of nonuniformity and nonhomogeneity in the field, which can be somewhat captured using larger sized samples, but will not be adequately characterized with smaller sized samples.

This study will investigate issues similar to those expressed by Chew and Bharati (2011). Although, the triaxial specimens tested in the present study are comprised of disturbed samples obtained from vibratory sonic drilling and were not obtained from a large sized sampler as done by Chew and Bharati (2011). The samples from the Tremonton site were also reconstituted in sample molds and some oversized particles removed from the smaller diameter (i.e., 2.8 in.) samples. However, subsequently a series of larger diameter (i.e., 6 in.) triaxial tests were performed where larger diameter particles were retained in the sample for comparative purposes, as described later. Nonetheless, the fabric or structure of the reconstituted samples may vary greatly from the in situ conditions of the soils due to the possible destruction of natural cementation and the overall change of orientation of the soil particles. Although the samples were carefully reconstituted, the nature of voids within the samples may be significantly different than that of the in situ soil, especially for the 6 in. diameter samples. Ultimately, these issues may significantly influence the shear strength properties of the laboratory tested soils when compared with the in situ values.

Lastly, a comparison of the shear strength results from both the large and small diameter triaxial compression tests conducted for this study is presented in Chapter 7. Further discussion and implementation of the results are also presented.

2.3 Becker Penetration Testing

Although the standard penetration test (SPT) is one of the most commonly used in-situ tests for site investigations and liquefaction analysis, the results of the (SPT) test may be very unreliable in gravelly soils, often resulting in SPT N values that are significantly higher than sandy soils. Hence, SPT N values may not be reliable for design in gravelly soils. In addition, the larger particles found within gravelly soils make SPT sampling techniques very problematic when trying to recover representative disturbed samples due to the potential plugging of the sampler by the larger diameter particles. In addition, as discussed in subsequent sections, the sample fabric is often changed when performing conventional triaxial compression tests on reconstituted samples because the larger particles are often removed from the smaller diameter samples typically used in the conventional test.

To overcome some of the sampling issues in gravelly soils, the Becker hammer drill was developed in the 1950s by Becker Drills in Alberta, Canada. The drill is used to drive a double-walled casing pipe through gravelly and cobbley material with a double-action diesel hammer. The casing can be open or closed-ended, used without compressed air, and analyzed as a large scale penetration test to model pile driving. Also, the open-ended casing can be driven with a harden drive bit for drilling and sampling, in which case compressed air is forced down through the annulus of the casing to flush the soil cuttings up through the center of the pipe to a cyclone located at the ground surface (Sy and Campanella, 1994). The cyclone then spits the cuttings onto the ground surface and then very disturbed bulk samples can be collected.

During the test the number of blows required to advance the casing 300 mm or approximately 1 ft is recorded and is called the Becker penetration test (BPT). These BPT blow counts have been converted to SPT blow counts for using in engineering correlations using methods described in Harder and Seed, 1986 and Sy and Campanella, 1994, which are explained below.

The first method was proposed by Harder and Seed (1986), and utilizes the BPT blow counts and bounce chamber pressures obtained during testing. First, using the BPT blow count correction chart **(**Fig. 2-1**)** proposed by Harder and Seed (1986), a data point is plotted using the field values of Becker hammer blow count (N_b) and the bounce chamber pressure. The value is plotted on the chart and brought back to the proposed A-line and the corrected blow count (N_{bc}) is obtained. That corrected blow count value is then used to determine the equivalent corrected SPT (N_{60}) value using a correlation between the corrected BPT blow count and corrected SPT blow count **(**Fig. 2-2**).** Harder and Seed (1986) suggested that casing friction had minimal effect on the Becker blow count and, therefore neglected it in their research.

The second method used to obtain the shear strength properties of the soil on site is one proposed by Sy and Campanella (1994). These authors suggested correcting the measured BPT blow count value for hammer performance by normalizing the hammer performance to a reference hammer energy transfer of 30%.

The field measurements can be normalized using Eq. 2-1, which is similar to the SPT

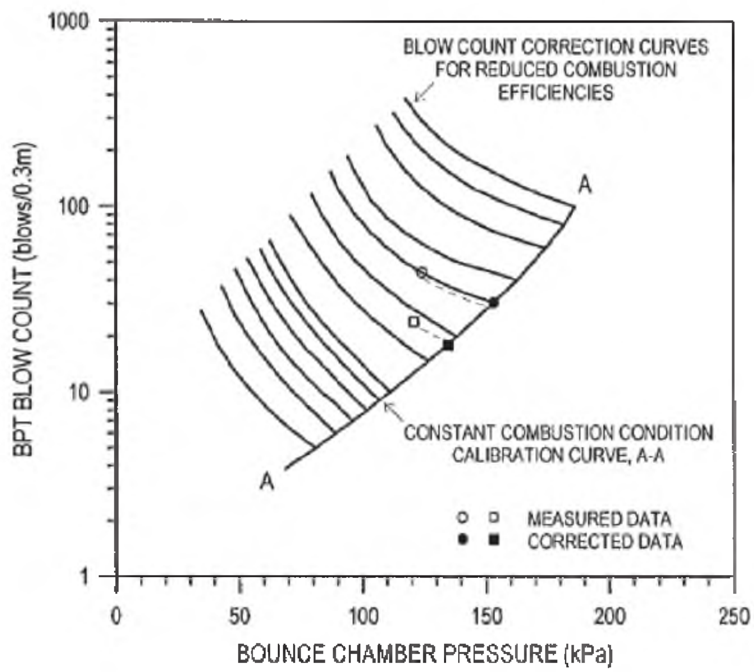

Fig. 2-1. BPT blow count correction chart based on bounce chamber pressure (Harder and Seed, 1986)

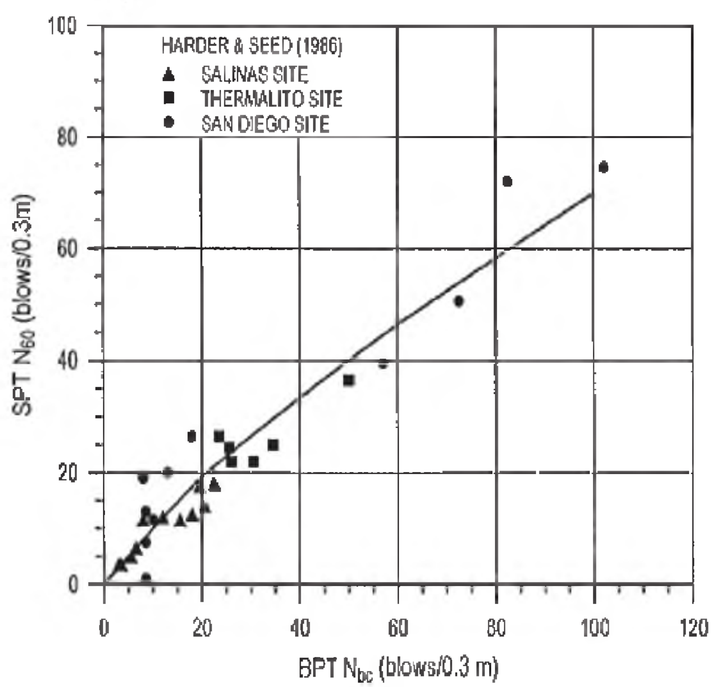

Fig. 2-2. Correlation between BPT blow count (N_{bc}) and corrected SPT (N_{60}) (Harder and Seed, 1986)

$$N_{b30} = N_b \cdot \frac{ETR}{30} \qquad \text{Eq. 2-1}$$

N_{60} correction technique where raw SPT N values are corrected to SPT N_{60} values by referencing them to the 60% energy transfer standard common for SPT hammers.

In addition, the skin friction (or shaft resistance) between the casing and the soil must be considered in the analyses. Such skin friction (R_s) values can be estimated from *CAPWAP* (Case Pile Wave Analysis Program) analyses or the *Case Method* from Rausche et al., (1985), using dynamic measurements. To obtain SPT N_{60} values, R_s and corrected BPT blow counts (N_{b30}) are used in conjunction with Fig 2-3, from Sy and Campanella (1994).

The relationship presented in Fig. 2-3 accounts for the effects of the skin friction along the casing and the variability of the energy delivered by the diesel hammer. After obtaining the corrected SPT N_{60} values, these are then normalized using Eq. 2-2.

$$(N_1)_{60} = N_{60}\sqrt{\frac{p_A}{\sigma'_{v0}}} \qquad \text{Eq. 2-2}$$

2.4 *P-y* Curves from Pressuremeter Data

The development of *P-y* curves (i.e., lateral load versus deflection curves) to analyze the behavior of laterally loaded piles is widely used in geotechnical practice. *P-y* curves can be developed analytically utilizing empirical correlations and determined shear strength characteristics of the soil, and also utilizing the field test results of the pressuremeter (PMT). The data obtained from a pressuremeter test is provided in terms of pressure in the hydraulic lines and radial expansion of the membrane in the probe,

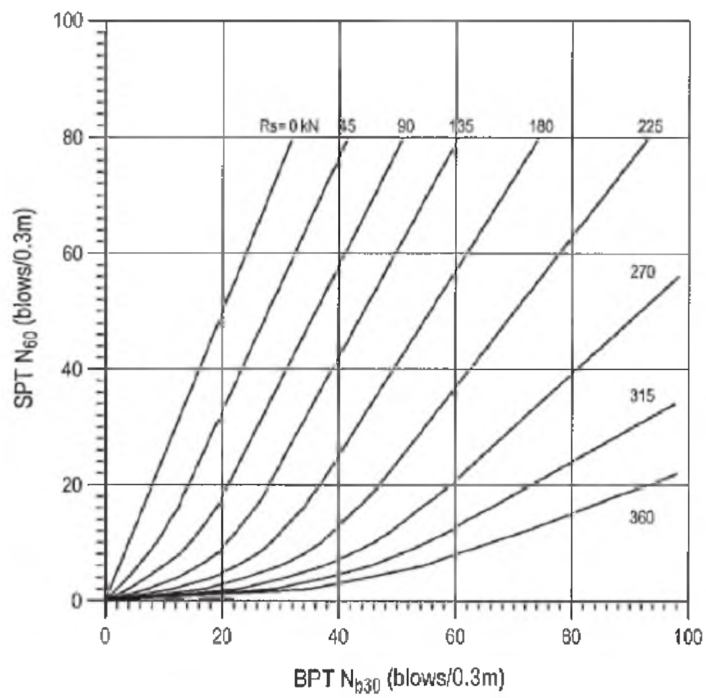

Fig. 2-3. Computed BPT-SPT correlations for different BPT shaft resistances (R_s) (Sy and Campanella, 1994)

making it possible to construct a *P-y* curve. The behavior expansion of the pressuremeter probe is very similar to the loading on the soil due to the lateral deflection of a laterally loaded shaft. Briaud (1992) and Smith (1987) were used in this study to develop the *P-y* curves from the raw pressuremeter data obtained in this study.

2.5 Analytical Methods to Develop P-y Curves

The method of developing *P-y* curves from pressuremeter data can be a very reliable way to determine the lateral deformation characteristics of the subsurface materials at a given site. Unfortunately, due to cost constraints and in-situ conditions, the pressuremeter is not always a viable option. However, other empirical methods have been developed based on separate site-specific investigations to estimate the *P-y* curves for various soil conditions using other in-situ and laboratory tests.

This study makes use of the software program *LPILE*™, which uses the *P-y* method for analyzing the lateral capacity of piles for a specified subsurface profile. This method was derived from correlations from the results of site-specific full-scale load tests. *LPILE* models the response of the soil due to lateral loads on the pile as a series of discrete nonlinear springs as shown in Fig. 2-4.

Two different soil types utilized from the list provided in *LPILE* for this study were "Sand (Reese)," and "Stiff Clay without free water." The development of P-y curves for each soil type is discussed below as summarized within the *LPILE* Technical Manual, Ensoft (2011). An axial load Q, a lateral load V, and a nominal moment M, are input into the program and used in conjunction with the *P-y* strength and deformation properties of the soil profile. Results for the analysis of the laterally loaded shaft are provided in terms of rotation, displacement, bending moment, and shear using Eq. 2-3 through Eq. 2-6.

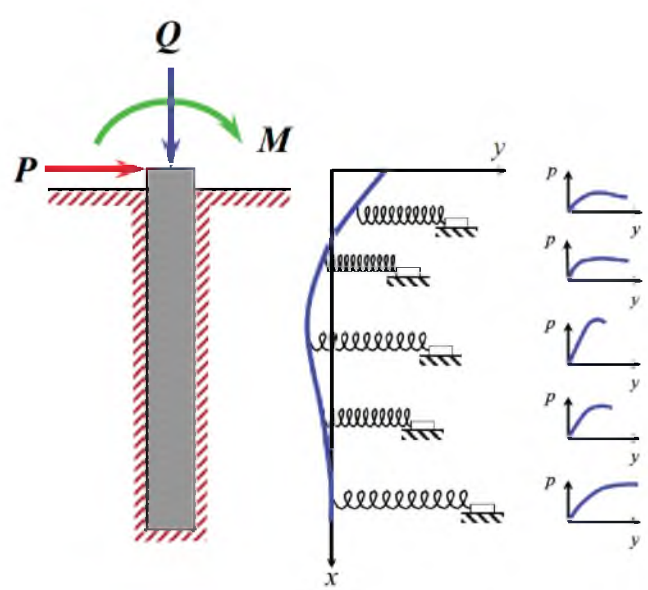

Fig. 2-4. Example of a laterally loaded shaft modeled by discrete nonlinear springs (*LPILE* Technical Manual, Ensoft, 2011)

$$EI\frac{d^4y}{dx^4}+Q\frac{d^2y}{dx^2}-p+W=0 \qquad \text{Eq. 2-3}$$

$$V=EI\frac{d^3y}{dx^3}+Q\frac{dy}{dx} \qquad \text{Eq. 2-4}$$

$$M=EI\frac{d^2y}{dx^2} \qquad \text{Eq. 2-5}$$

$$S=\frac{dy}{dx} \qquad \text{Eq. 2-6}$$

where:

EI = flexural rigidity of the shaft,

y = lateral deflection of the shaft at a point x along the length of the shaft,

p = soil resistance per unit length of the shaft,

Q = axial load on the shaft,

W = distributed load along the length of the shaft,

V = shear in the shaft,

M = bending moment in the shaft, and

S = slope of the elastic curve defigned by the deformed shape of the shaft.

2.5.1 P-y Curves for Stiff Clay without Free Water

The procedure for developing *P-y* curves in stiff clay without the presence of free water, as used in *LPILE*, is based on site-specific research reported in papers by Welch and Reese (1972) and Reese and Welch (1975), and is further described in the *LPILE*

Technical Manual. The first step in developing the *P-y* curve is to obtain values for the undrained shear strength s_u, soil unit weight γ, pile diameter b, and ε_{50}. The ultimate resistance, p_u, is then calculated by taking the lower value given by equations Eq. 2-7 and Eq. 2-8. For Eq. 2-7, the shear strength is taken as the average from the ground surface to the depth being considered and *J* is taken as a value of 0.5.

$$p_u = \left[3 + \frac{\gamma_{avg}}{s_u}x + \frac{J}{b}x\right]cb \qquad \text{Eq. 2-7}$$

$$p_u = 9cb \qquad \text{Eq. 2-8}$$

The next step is to compute the value y_{50}, which is the deflection at one-half the ultimate soil resistance, using Eq. 2-9. The points describing the P-y curve are then computed using the relationship shown in Eq. 2-10. The value for the soil resistance p_s is taken as the ultimate soil resistance p_u, for all values deflection y, beyond the relations expressed in Eq. 2-11. A typical P-y curve for the soil type "Stiff Clay without Free Water" is shown in Fig. 2-5.

$$y_{50} = 2.5\varepsilon_{50}b \qquad \text{Eq. 2-9}$$

$$p = \frac{p_u}{2}\left(\frac{y}{y_{50}}\right)^{0.25} \qquad \text{Eq. 2-10}$$

$$y = 16y_{50} \qquad \text{Eq. 2-11}$$

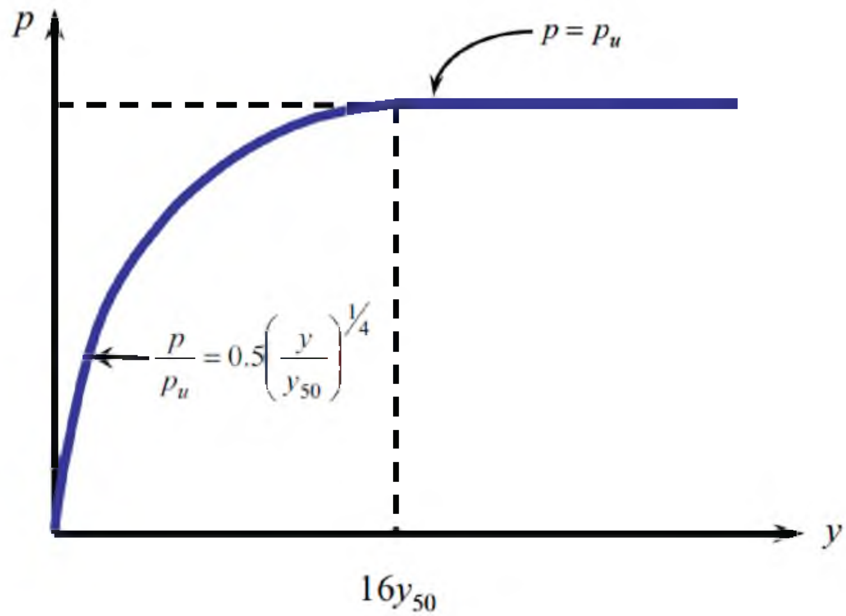

Fig. 2-5. A typical *P-y* curve for the soil type "stiff clay without free water" (*LPILE* Technical Manual, Ensoft, 2011)

2.5.2 P-y Curves for Sand

This study also utilized the *LPILE* soil type option of "Sand" based on the investigations and methods reported by Reese (1974), which are described in the *LPILE* Technical Manual. The first step in this method is to obtain values for the angle of internal friction ϕ, the effective unit weight γ, and pile diameter b. After determining the value for the anlge of internal firction, Eq. 2-12 through Eq. 2-15 are utilized.

$$\alpha = \frac{\phi}{2} \qquad \text{Eq. 2-12}$$

$$\beta = 45° + \frac{\phi}{2} \qquad \text{Eq. 2-13}$$

$$K_o = 0.4 \qquad \text{Eq. 2-14}$$

$$K_A = \tan^2\left(45° - \frac{\phi}{2}\right) \quad \text{Eq. 2-15}$$

The ultimate soil resistance per unit length of the shaft can then be calculated by using Eq. 2-16 through Eq. 2-20. When calculating p_s, first find the depth x_t at which there is an intersection at Eq. 2-17 and Eq. 2-18. Above this intersection depth use Eq. 2-17. Below this depth, use Eq. 2-18. Establish the deflection point at which the ultimate lateral pressure for a given depth starts using Eq. 2-19. Determine the $\overline{A}$ coefficient using Fig. 2-6 for the particular nondimensional depth, and for either the static or cyclic case. Use Fig. 2-7 to determine the appropriate B coefficient, using either the B_s curve for static conditions or B_c curve for cyclic conditions. The ultimate soil resistance p_u, can then be calculated using Eq. 2-20.

$$p_s = \min[p_{st}, p_{sd}] \quad \text{Eq. 2-16}$$

$$p_{st} = \gamma x \left[\begin{array}{l} \dfrac{K_O \tan\phi \sin\beta}{\tan(\beta - \phi)\cos\alpha} + \dfrac{\tan\beta}{\tan(\beta - \phi)}(b + x\tan\beta\tan\alpha) \\ + K_O x \tan\beta(\tan\phi\sin - \tan\alpha) - K_A b \end{array} \right] \quad \text{Eq. 2-17}$$

$$p_{sd} = K_A b\gamma x(\tan^8\beta - 1) + K_O b\gamma x \tan\phi \tan^4\beta \quad \text{Eq. 2-18}$$

$$y_u = \frac{3b}{80} \quad \text{Eq. 2-19}$$

$$p_u = \overline{A} p_s \quad \text{Eq. 2-20}$$

Compute values for y_m and p_m, using Eq. 2-21 through Eq. 2-22. The two straight-line portions of the *P-y* curve, beyond the point where y is equal to $b/60$, can now be

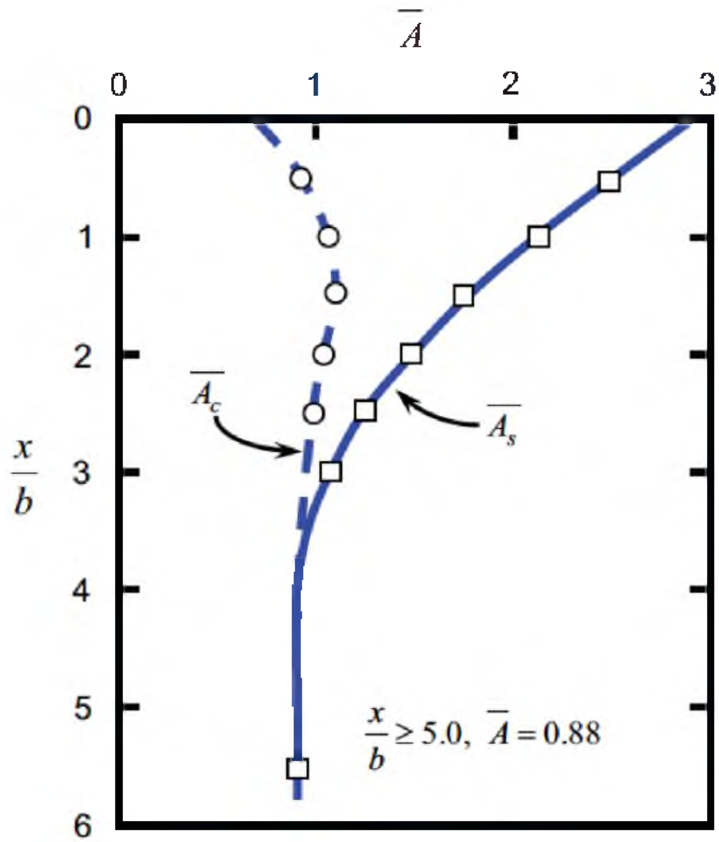

Fig. 2-6. $\overline{A}$ coefficient for static and cyclic loading cases (*LPILE* Technical Manual, Ensoft, 2011)

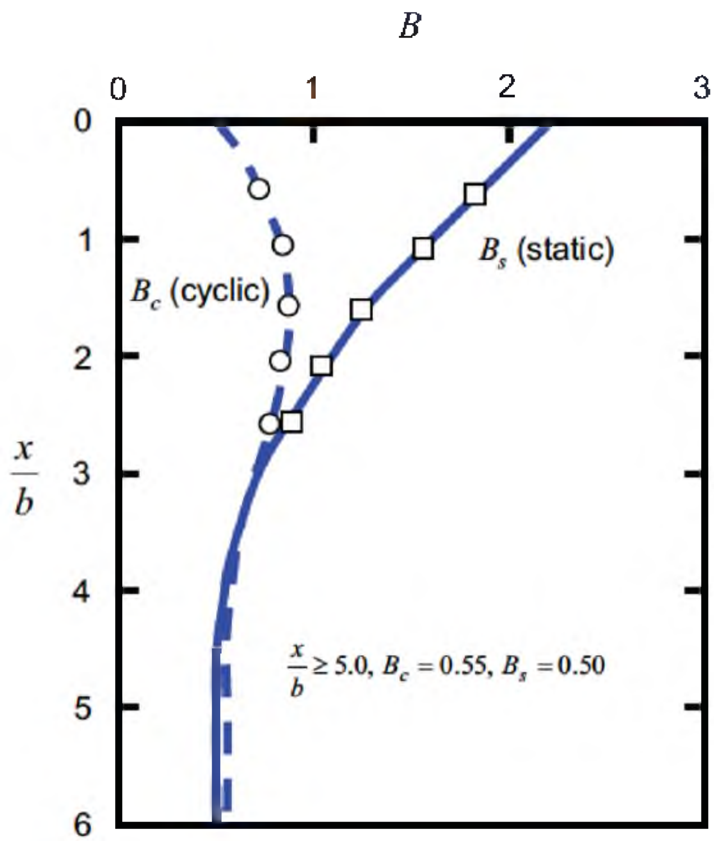

Fig. 2-7. *B* coefficient for static and cyclic loading cases (*LPILE* Technical Manual, Ensoft, 2011*)*

established. The initial portion of the *P-y* curve was first introduced by Terzaghi (1955), and is a function of the soil modulus *k*, and the depth below the ground surface as shown in Eq. 2-23.

$$y_m = \frac{b}{60} \qquad \text{Eq. 2-21}$$

$$p_m = B_s p_s \qquad \text{Eq. 2-22}$$

$$p = (kx)y \qquad \text{Eq. 2-23}$$

Terzaghi recommended that his method be used up to the point where the computed soil resistance was equal to about one-half the ultimate bearing stress. The rest of the *P-y* curve is developed using Eq. 2-24 through Eq. 2-28. The procedure for developing the *P-y* curves for sand is illustrated in Fig. 2-8.

$$p = \overline{C}y^{1/n} \qquad \text{Eq. 2-24}$$

$$m = \frac{p_u - p_m}{y_u - y_m} \qquad \text{Eq. 2-25}$$

$$n = \frac{p_m}{my_m} \qquad \text{Eq. 2-26}$$

$$\overline{C} = \frac{p_m}{y_m^{1/n}} \qquad \text{Eq. 2-27}$$

$$y_k = \left(\frac{\overline{C}}{kx}\right)^{\frac{n}{n-1}} \qquad \text{Eq. 2-28}$$

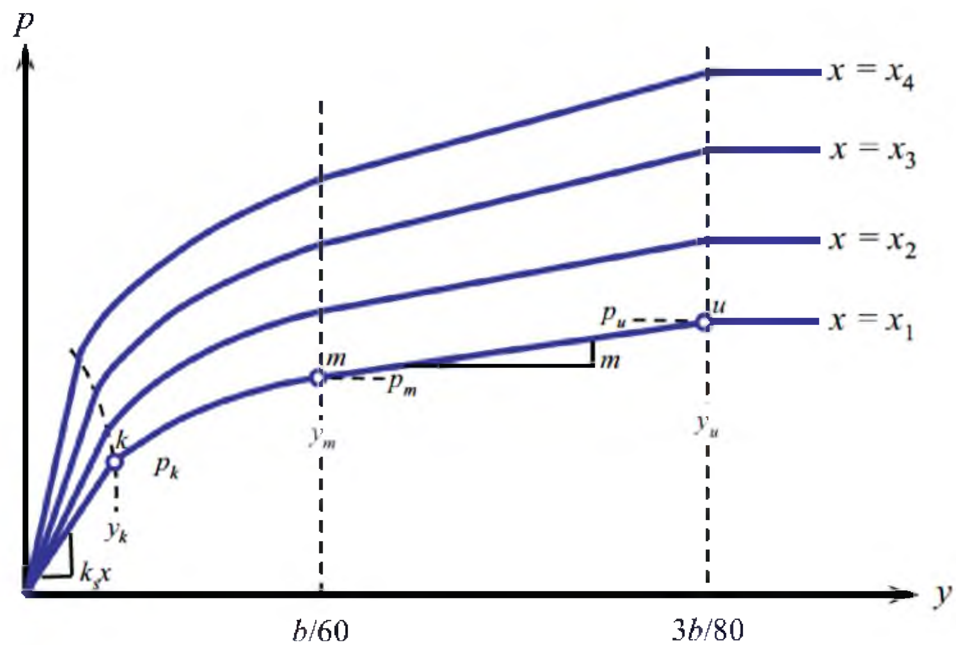

Fig. 2-8. Method for constructing *P-y* curves for sand (*LPILE* Technical Manual, Ensoft, 2011)

2.6 Summary

Background information for some of the field and laboratory methods used to determine strength and deformation characteristics was provided in this chapter. The information provided gave a brief history and summary of each of the methods and discussed their applicability to the present study. The implementation and reduction of the data acquired from these methods will be discussed in more detail in subsequent chapters, and the final results from each test will be provided.

3 GEOLOGICAL INVESTIGATION

3.1 Overview

All investigations for this study were performed for a site located on PacifiCorp's transmission line occupied by a dead end transmission line structure located at the base of a hillside located northwest of Tremonton, Utah. The site is located in Box Elder County and has coordinates of 41°43'43.654"N and 112°11'46.347"W in Box Elder County. This site is located in the Basin and Range Province near the Wasatch Front mountain range. This site is near several bodies of water that include the Great Salt Lake, Cutler Reservoir, Willard Bay, and Bear River. The ground surface at the site is approximately 4385 ft above mean sea level (Google Earth), and is situated on the base of a hillside with a slope to the southwest (Figure 3-1).

3.2 Regional and Local Geology

The subject site is located along the eastern edge of Basin and Range Physiographic Province, or "Great Basin," where this province borders with the Wasatch Range in Northern Utah. This range is part of the Middle Rocky Mountain Province (Fig. 3-2**)** and greatly influences the physiography of this area. The subject site is located in an adjacent intermountain valley just west of the Wasatch Range in Northern Utah. This valley is a large graben filled with unconsolidated and semiconsolidated sediments of primarily lacustrine and alluvial origin.

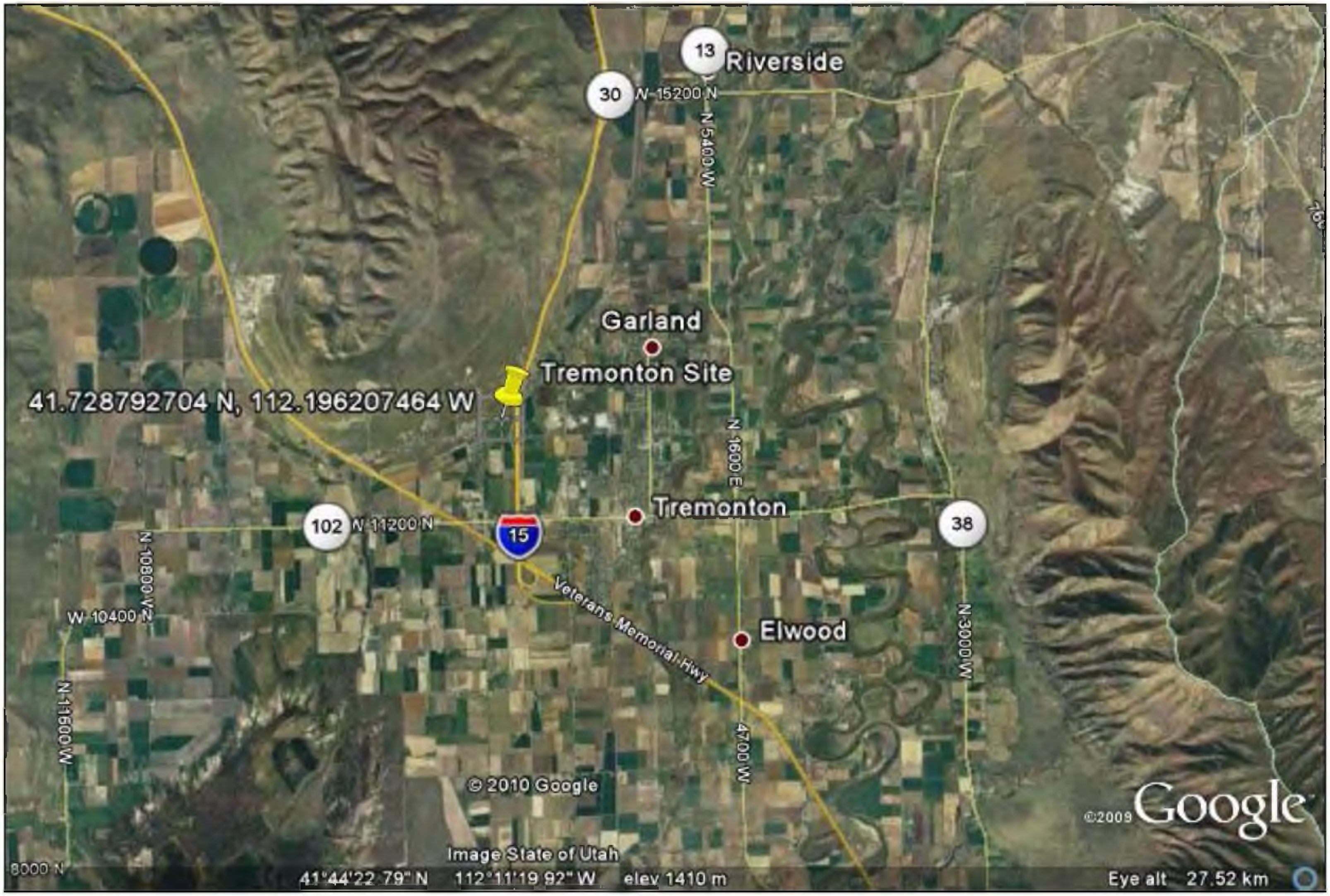

Fig. 3-1. Aerial view of the location of the Tremonton site (Google, 2009)

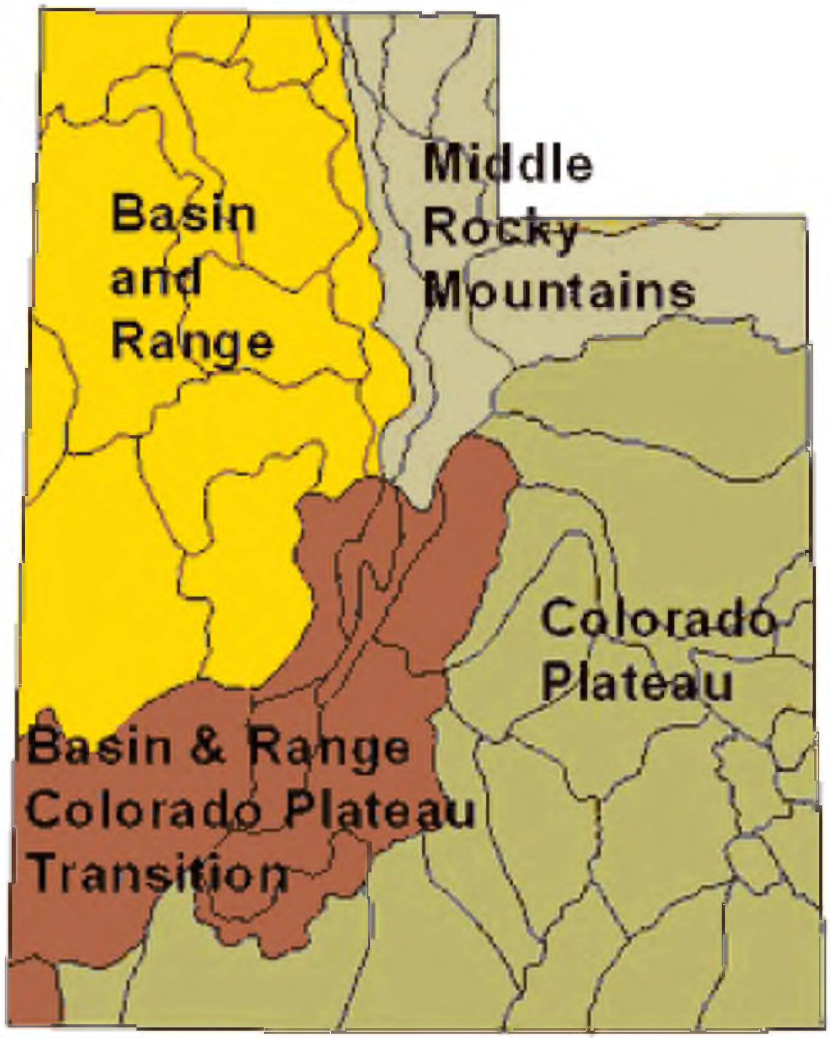

Fig. 3-2. Physiographic provinces of Utah (Utah Geologic Survey, 2011)

Box Elder County, Utah can be further divided into three physiographic types (UGMS, 1980). The first type consists of the mudflats of the Great Salt Lake Desert and the shorelines of the Great Salt Lake. These shorelines are very flat and have a shallow ground water table. The second type is mountainous land, which consists mainly of hard, conolidated bedrock and its weathered products. The major bedrock types found here are limestone, dolomite, quartzite, and extrusive (i.e., volcanic) rocks of various types. The third physiographic type is a broad slope that surrounds the mountains and extends to the edges of the mudflats. This slope consists of alluvial fans, bajadas, pediments, lake terraces and other fluvial and lacustrine landforms. The subject site is located within the third physiogeographic type.

The surficial geology maps for this area show that the Box Elder County sites consist of Quaternary age soils. During this period, much of Box Elder County was episodically inundated by large, freshwater lakes; the youngest of these was Lake Bonneville that existed between 32,000 and 14,000 years before the present time (Utah Geologic Survey, 2011). The waters of Lake Bonneville inundated the western part of the Great Basin, where at its highest level, the lake waters flooded many of Utah's intermountain valleys located west of the Wasatch Front. Its waters also extended into southern Idaho and eastern Nevada **(**Fig. 3-3**).** The present Great Salt Lake is an evaporative remnant of this larger, freshwater lake. Lake Bonneville and its deposits have greatly influenced the current geomorphology of Box Elder County. Numerous terraces, bars, and spits formed formed along its margins near the mountain fronts.

The lake also helped created the extremely flat surface of the Great Salt Lake Desert and the Bonneville Salt Flats located to the west of the investigation sites. The

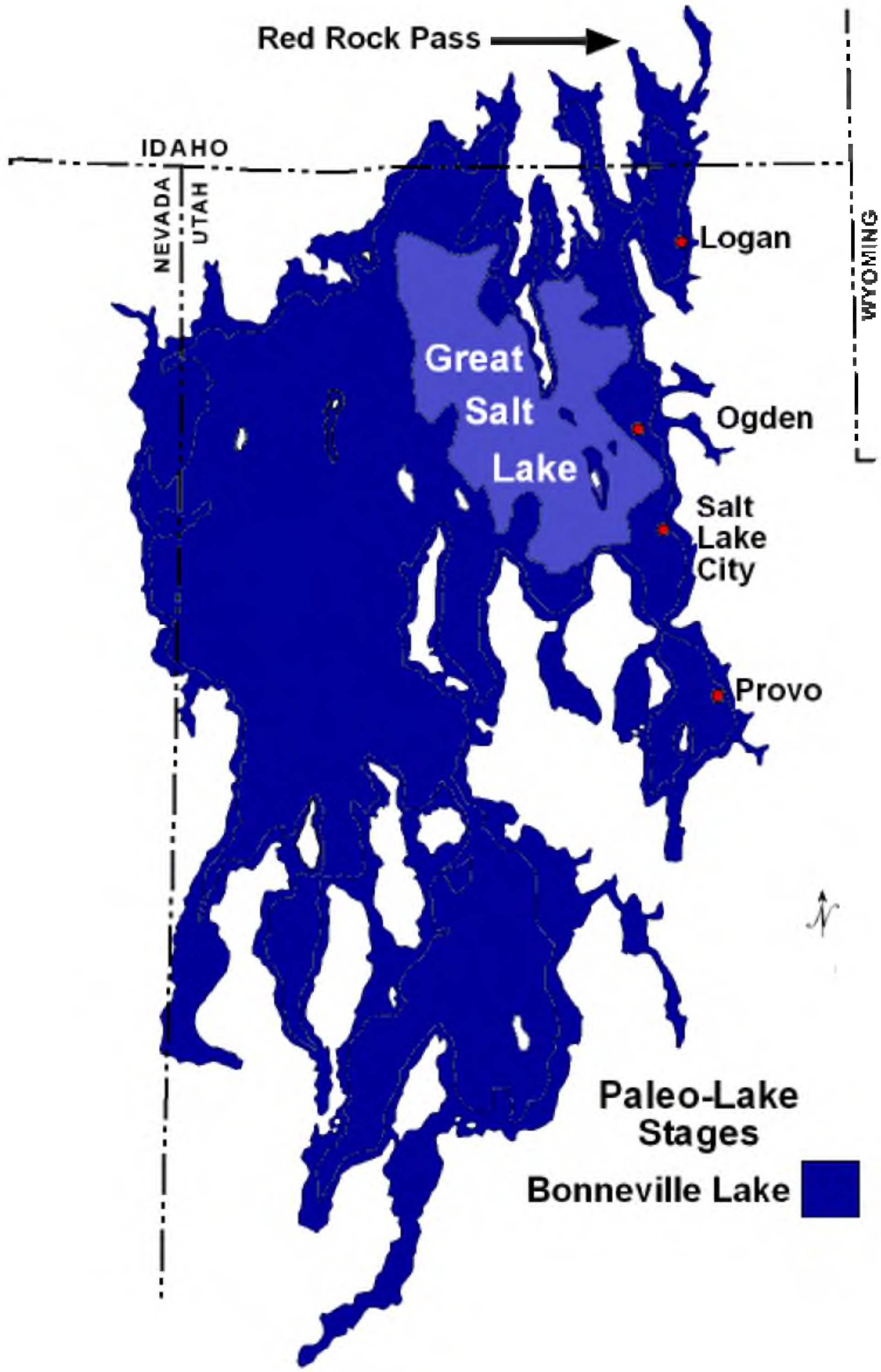

Fig. 3-3. Greatest extent of Lake Bonneville (Utah Geologic Survey, 2011)

deposits formed by Lake Bonneville can be divided into four general groupings: (a) lake clays, muds and silts, (b) sand and gravel deposits, (c) diatomaceous marl, and (d) ice-rafted deposits (UGMS, 1980). The shallow soils at the subject site consists of gravelly deposits of alluvial / colluvial origin.

The project site is located at the margins of geological units *Qg* and *Qlc,* based on the geological map of Doelling (1980). The *Qg* unit is composed of gravels with minor sands, silts, and clays. The *Qlc* unit is comprised of predominately lacustrine clay or silt deposits of Lake Bonneville with minor mostly fine-grained deposits of alluvial, colluvial or aeolian origin. This site is shown at the interface between surficial older alluvium / colluvium (*Qao*) and more recent alluvium (*Qa*) using the State of Utah Geographic Information Database (http://gis.utah.gov/sgid) (Fig. 3-4**).** Because lacustrine deposits (*Qlc*) are mapped just south of this site, it is possible that alluvial / colluvial deposits overly lacustrine deposits of Lake Bonneville at the locale.

A previous separate boring log was provided by PacifiCorp from the initial investigation performed by the contractor hired for the subject site, and it indicates that the subsurface soils are predominately very stiff to hard gravelly and sandy clays to a depth of about 65 ft. Lacustrine deposits may be present in deeper strata.

3.3 Geologic Conditions and Potential Hazards

3.3.1 Groundwater Conditions

Based on the preliminary borehole provided, the groundwater table in this area is approximately 30 ft below the ground surface. There was no indication of artesian conditions at this site.

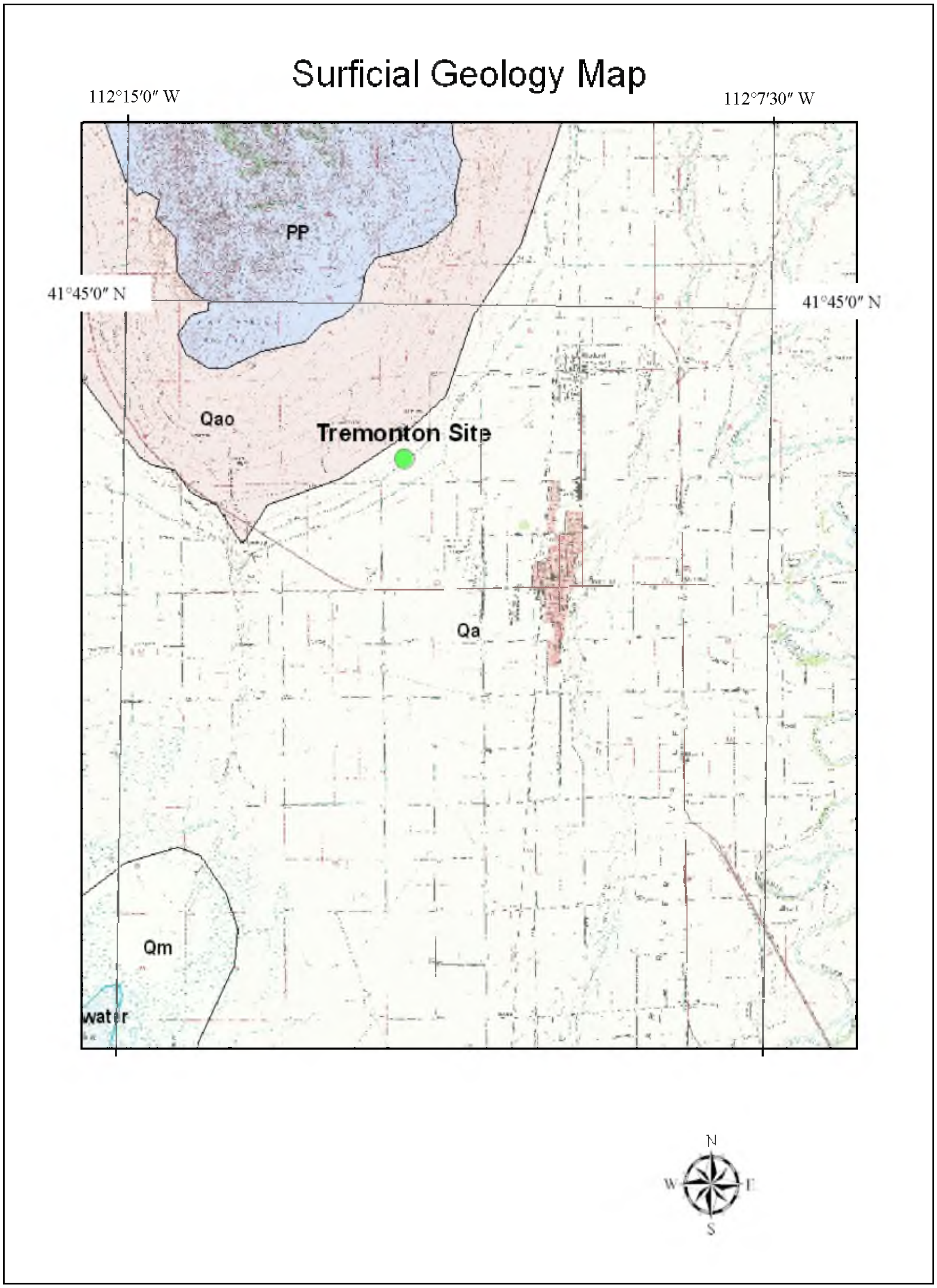

Fig. 3-4. Surficial geology map of the Tremonton site (Utah's State Geographic Information Database, 2009)

3.3.2 *Surficial Soils*

The surficial and shallow clay deposits found at this site probably have a low to moderate shrink-swell potential. Because of the relatively high clay content, these soils do not appear to have a high collapse potential. However, alluvial silt layers, if found at this location, should be evaluated further for collapse potential.

3.3.3 *Earthquake Hazards*

The main trace of the Wasatch Fault is approximately 6 miles east of the Tremonton site (Fig. 3-5). Therefore, the Tremonton site is not vulnerable to ground displacement resulting from fault rupture. The expected peak ground acceleration (PGA) on soft rock (i.e., site class B) near the Tremonton site ranges from about 0.29g to 0.35g with a 10% probability of exceedance in 50 years (Fig. 3-6). Based on the surficial geology and preliminary borehole log provided by PacifiCorp, the Tremonton site is designated as a class C site with little potential for liquefaction due to the dense and somewhat gravelly, clayey soils found at this location.

3.3.4 *Landslide Potential and Mass Movement*

This site is not found within a potential landslide area (Fig. 3-7). Landsliding is unlikely at this site due to the gently sloping terrain and relatively dense granular deposits. In addition, the rather deep groundwater table and presence of overlying stiff, dry soils make this an unlikely location for future landsliding.

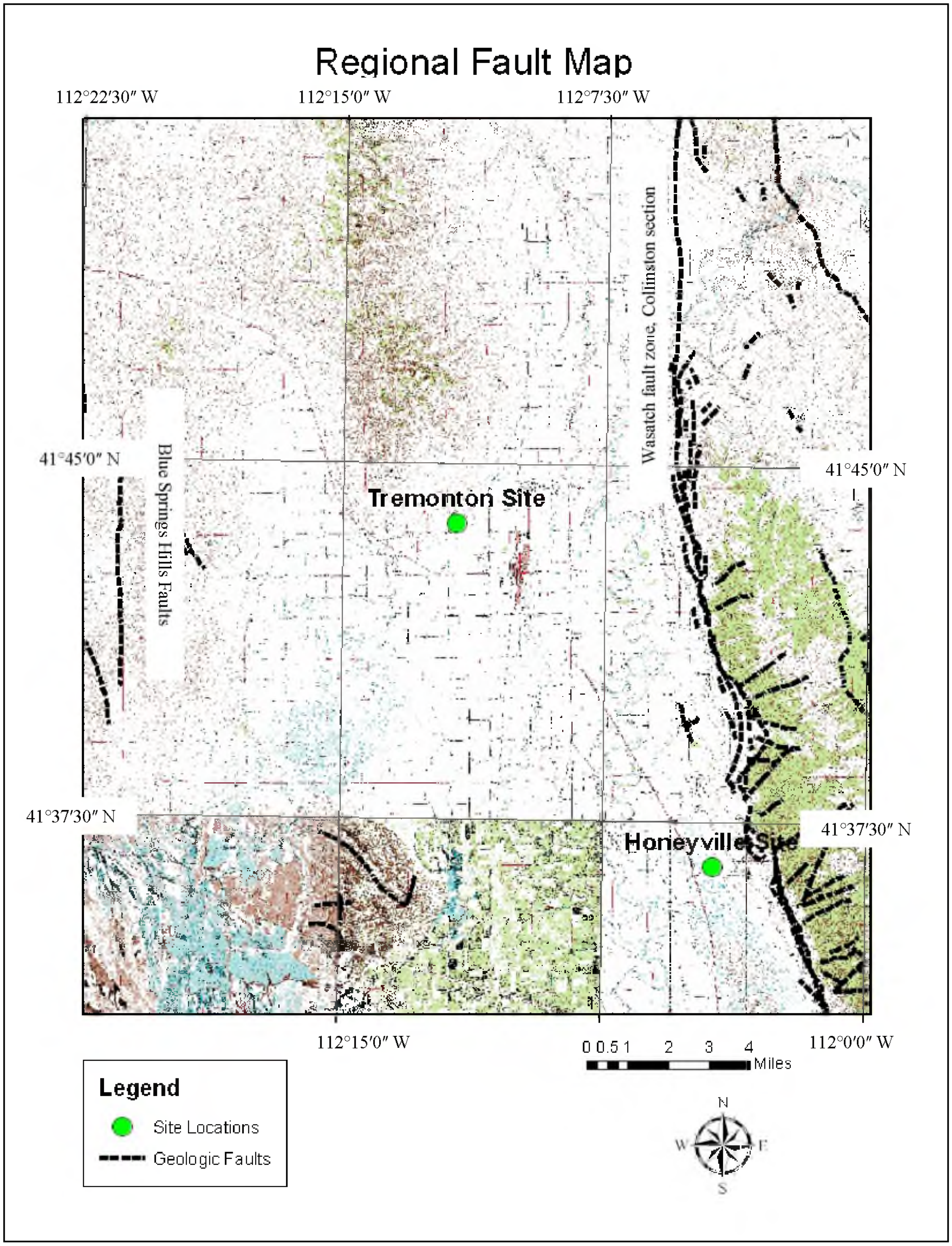

Fig. 3-5. Regional fault map for Box Elder County, Utah (Utah's State Geographic Information Database, 2009)

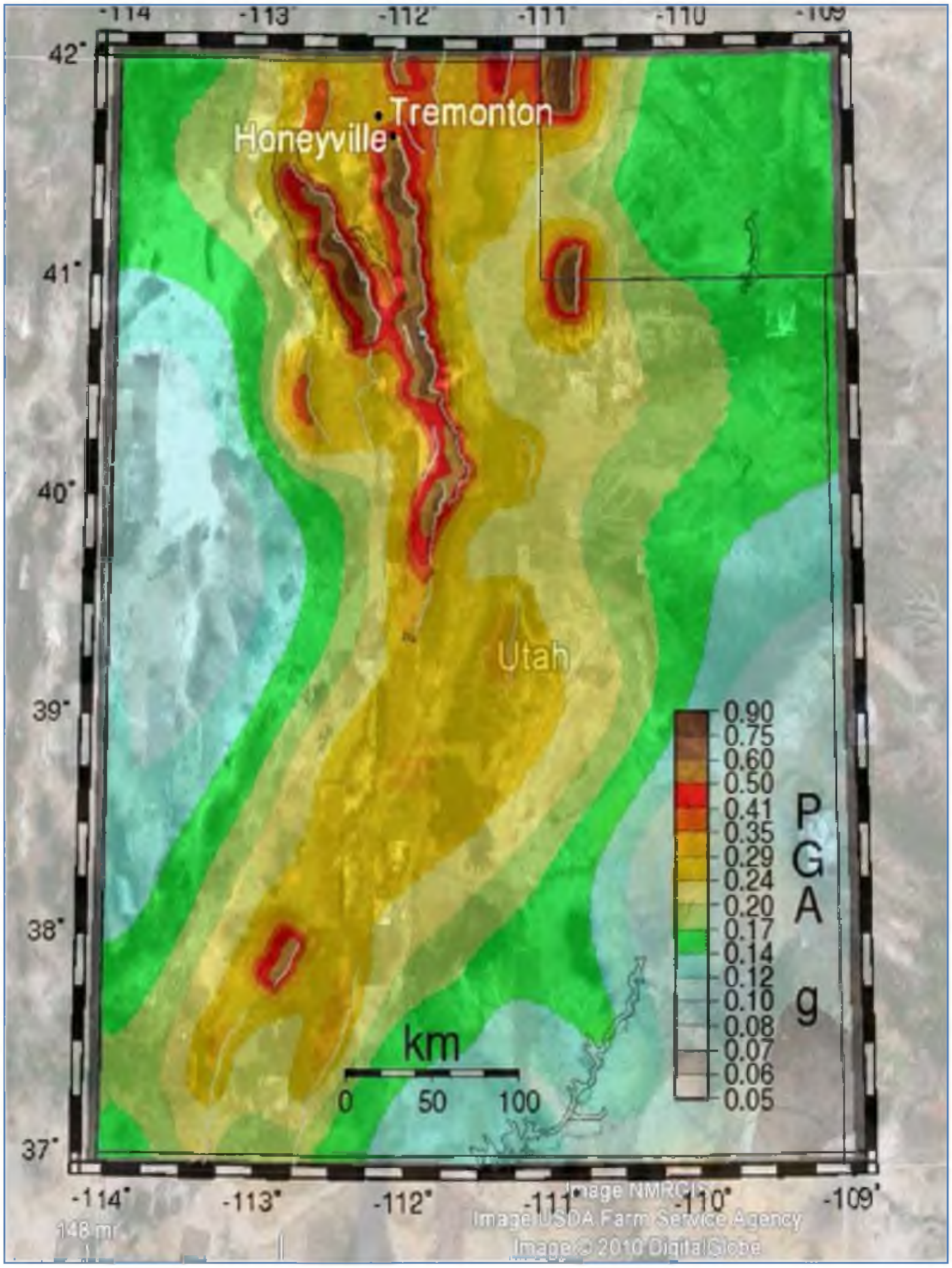

Fig. 3-6. Estimates of PGA for Utah with a 10% probability of exceedance in 50 years (United States Geologic Survey, 2010)

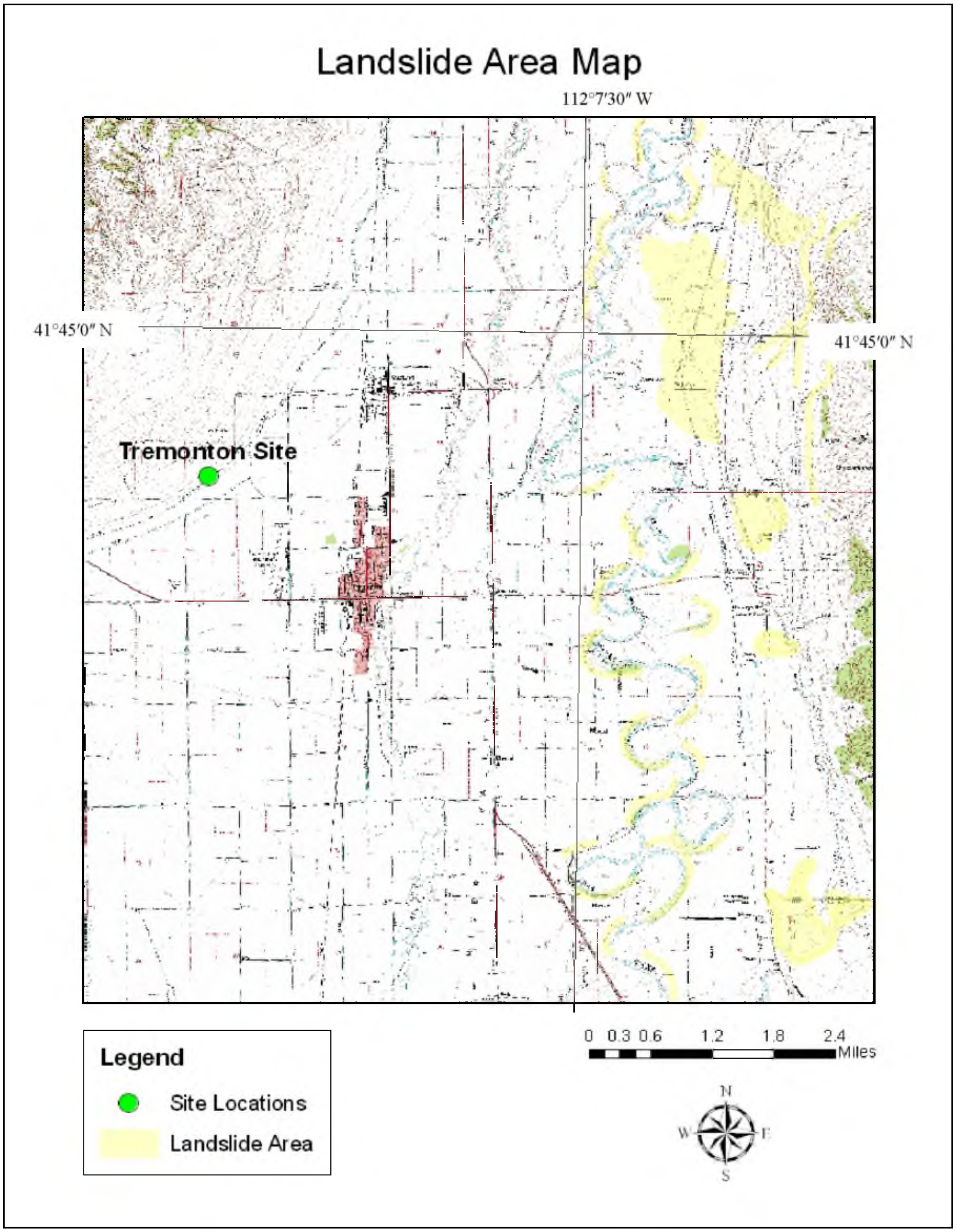

Fig. 3-7. Landslide potential map of the Tremonton site (Utah's State Geographic Information Database, 2009)

3.3.5 *Flammable Gases*

No flammable gases were detected at this project site during investigation. No further recommendations were deemed necessary.

3.3.6 *Other Considerations*

The soils at the Tremonton site are potentially corrosive and may have a high alkaline content. Resistivity testing and chemical analyses are recommended for this site. In addition, local surface erosion from snow melt runoff is a potential concern due to the site being at the base of a hillside.

3.4 Summary

The local and regional geography of the project site was described in this chapter in terms of geological formations and potential geologic hazards. In terms of geological formations the site is located in a region with soils comprising of alluvium, colluviums, and lacustrine deposits. It was also concluded that significant geologic hazards, except for earthquake strong motion are of little concern to this investigational study.

4 FIELD INVESTIGATION

4.1 Overview

The subsurface investigation at the project site included an array of generally accepted sampling and exploratory methods as well as in-situ testing to investigate the subsurface conditions. Based on the preliminary geological data stated in the historic geological maps discussed in Chapter 3, and prior subsurface explorations by Black and Veatch (2009), the site was assumed to be comprised of alluvium, colluvium, and lacustrine deposits which are usually a variety of gravels, sands, clays, and silts. The field investigations completed for the subject site were initially limited to vibratory sonic drilling and sampling as well as pressuremeter testing (PMT). However, it was determined that additional exploratory methods need be applied and the final list included cone penetration testing (CPT) and Becker hammer testing (BPT) to achieve more of a detailed subsurface profile and strength parameters for design considerations.

4.2 Sonic Drilling and Sampling

The soil profile at the subject site consists of alluvial and colluvial soils that have been deposited at the base of low lying hills near the ancient shore of Lake Bonneville. They are considerably more granular and dense compared to the lacustrine deposits found in surrounding soils. Subsurface conditions at the subject site were investigated using continuous borings from the ground surface to a depth of 65 ft. In addition to soil investigations, the evaluations also considered subsurface conditions that might adversely impact construction (e.g., artesian groundwater conditions, liquefiable sand layers, potential difficulties in excavating site soils, and the potential for caving of granular soils during drilled pier excavations).

Drilling and sampling at the site took place on July 19, 2010. The drilling was performed by a two man crew from Boart Longyear using a mini sonic drilling rig. This rig was equipped with a 6 in. diameter core barrel, and a continuous core was obtained to a target depth of 65 ft at a location about 15 ft west of the centerline of an existing dead end transmission line structure. The main objective of the drilling was to retrieve continuous sample from the site to characterize the subsurface soils adjacent to the structure including soil classification, moisture-density, and variability of soil layers.

The mini sonic drilling rig was chosen due to its good performance in the dense, granular subsurface conditions that were expected at the subject site. The mini sonic drilling rig was transported on a flat-bed trailer to the site location and then positioned at the drilling location using its rubberized track system operated by remote control. The borehole was drilled to the target depth by rotating and vibrating the casing at resonant sonic frequencies while keeping the bit face open with high-pressure fluid. The drill barrel rotated hydraulically and vibrated up and down as it was pushed downward through the soil. Depending on soil conditions encountered, the drill rig operator was able to adjust the sonic frequency to suit the type of soil, allowing quicker penetration than conventional drilling methods. This method allowed for drilling to continue through mixed and dense soils where other methods would be hindered. This drilling method proved to be extremely useful at the site because most of the soils encountered were dense mixtures of sands, silts, clays, gravels, and cobbles.

Only disturbed samples could be retrieved for subsequent laboratory testing due to the nature of the drilling method (Fig. 4-1). The continuous samples were placed into individual bags approximately 2.5 ft long and 6 in. in diameter. Fig. 4-1 shows an example of the disturbed sample obtained from the sonic drilling method. This method produced a large amount of soil for the subsequent laboratory testing. As part of the drilling and sampling process, standard penetration tests (SPT) were performed with a nonstandard 2.5 in. outer diameter (O.D.) and 2.4 in. inner diameter (I.D.) split spoon sampler, using an automatic trip hammer. SPT blow counts (N_{SPT}) were recorded for three 6 in. intervals. The SPT was performed at 5 ft intervals; however, at some locations the SPT was stopped because the material was dense or the sampler hit pieces of gravel or cobble.

Fig. 4-1. Bulk sample obtained from sonic drilling

The N_{SPT} were calculated by summing the number of blows for the last two 6 in. intervals (Table 4-1). In addition, it is felt that many of the calculated N_{SPT} are not representative of field conditions due to the presence of large, cobble-sized particles that plugged the end of the sampler and artificially increased the N_{SPT}.

In addition to N_{SPT}, SPT-Torque (SPT-T) tests were conducted (Table 4-1). These tests were conducted immediately after the sampler had driven its final 6 in. interval. The SPT-T was performed by applying torque via a torque wrench attached to the top of the drill rod and recording the maximum value of torque measured by the torque wrench. The applied torque produces a torsional shear condition along the interface of the outer surface of the split spoon and the adjacent soil. The torque measurement gives a direct indicator of the torsional side resistance along the spoon and soil interface as described in Lutenegger and Kelley (1998) and Kelley and Ltenegger (2004).

Table 4-1. Values of N_{SPT} and SPT-T for the Tremonton Site

Depth Range (ft)	N_{SPT} (blows/ft)	SPT-T (ft-lb)
5-6.5	58	225
10-11.5	84	250+
15-16.5	50/5"	250+
20-21.5	50/2"	200+
25-26.5	50/5"	175
30-31.5	50/3"	210
35-36.5	50/3"	220
40-41.5	50/1"	180
45-46.5	50/4"	180
50-51.5	50/4"	130
55-56.5	50/5"	75
60-61.5	50/5"	240
65-66.5	78	90

The sample bags were fastened, sealed and stored. Samples taken from above the groundwater table (approximately 32 ft) were stored in the laboratory. Samples obtained below the groundwater table were stored in a humidity room to help preserve their natural water content. The split spoon sample tubes were capped, sealed and stored in a similar manner with the bagged samples.

4.3 Determination of Unit Weight

Due to the highly disturbed nature of the bulk samples obtained from sonic drilling, an alternative method was used to determine the in situ soil density and moisture content of the soils within the upper 15 ft of the profile. This method consisted of using a truck-mounted utility pole auger to obtain sample and an on-site measurement of the volume and weight of the augered material. This field work was performed on September 21, 2010, a cylindrical hole was opened with a 1.5 ft diameter auger attached to the back of a PacifiCorp rig. The drilling was stopped at random depths and dimensional measurements of the cylindrical hole were taken to calculate the volume of the hole at each depth. All of the cuttings from the augering process were placed on an adjacent tarp and then shoveled into a wooden box for field weighing. The empty box was weighed as a reference tare weight. The soil-filled box was then weighed with an electronic scale, and the in situ soil density was calculated from the measurements. Moisture content samples were also obtained and bagged in plastic for laboratory determination of the in-situ moisture content. The field measurements are shown in Table 4-2 through Table 4-4. Samples from the split spoon sampling performed during the sonic drilling were also used to determine in situ soil density and moisture content in the laboratory (Table 4-5).

Table 4-2. Results of Field Density Tests Conducted at Tremonton Site (Depth 0 to 3.75 ft)

Box	Weight of Box + Soil (lb)	Weight of Soil (lb)	Unit Weight, γ (pcf)
1	120.6	97.4	91.9
2	128.7	105.5	
3	150.7	127.5	
4	155.9	132.7	
5	162.6	139.4	
6	99.6	76.4	
Total	818.1	678.9	

Table 4-3. Results of Field Density Tests Conducted at Tremonton Site (Depth 3.75 to 8.33 ft)

Box	Weight of Box + Soil (lb)	Weight of Soil (lb)	Unit Weight, γ (pcf)
1	127.3	104.1	135.4
2	161.3	138.1	
3	175.1	151.9	
4	166.9	143.7	
5	173.7	150.5	
6	168.2	145.0	
7	181.5	158.3	
8	169.9	146.7	
9	106.9	83.7	
Total	1431	1222	

Table 4-4. Results of Field Density Tests Conducted at Tremonton Site (Depth 8.33 to 14.5 ft)

Box	Weight of Box + Soil (lb)	Weight of Soil (lb)	Unit Weight, γ (pcf)
1	132.2	109	119.8
2	140.1	116.9	
3	150.6	127.4	
4	163.5	140.3	
5	140.7	117.5	
6	147.3	124.1	
7	138.7	115.5	
8	152.1	128.9	
9	154.7	131.5	
10	143.5	120.3	
11	169.6	146.4	
12	79.9	56.7	
Total	1713	1435	

Table 4-5. Values of Unit Weight from Split Spoon Samples from Tremonton Site

Sample (ft)	Sample Height (ft)	Sample Diameter (ft)	Sample Volume (ft^3)	Sample Weight (lbs)	Unit Weight, γ (pcf)	Average Unit Weight, γ (pcf)
5-5.5	0.354	0.19875	0.0110	1.148	104.5	
5.5-6	0.500	0.19875	0.0155	1.886	121.6	119.1
6-6.5	0.500	0.19875	0.0155	2.033	131.1	
10-10.5	0.417	0.19875	0.0129	1.436	111.1	
10.5-11	0.545	0.19875	0.0169	1.854	109.6	115.5
11-11.5	0.500	0.19875	0.0155	1.953	125.9	
15-15.5	0.500	0.19875	0.0155	1.646	106.1	111.7
15.5-16	0.500	0.19875	0.0155	1.818	117.2	
20-20.5	0.458	0.19875	0.0142	1.652	116.2	
20.5-21	0.500	0.19875	0.0155	1.822	117.5	117.1
21-21.5	0.500	0.19875	0.0155	1.827	117.8	
25-25.5	0.500	0.19875	0.0155	1.982	127.8	123.9
25.5-26	0.500	0.19875	0.0155	1.862	120.0	
30-30.5	0.500	0.19875	0.0155	1.641	105.8	109.9
30.5-31	0.417	0.19875	0.0129	1.475	114.1	
35-35.5	0.250	0.19875	0.0078	0.941	121.4	
35.5-36	0.500	0.19875	0.0155	1.868	120.4	127.7
36-36.5	0.500	0.19875	0.0155	2.191	141.2	
51-51.5	0.458	0.19875	0.0142	1.577	110.9	110.9
55-55.5	0.500	0.19875	0.0155	1.919	123.7	123.7
60-60.5	0.500	0.19875	0.0155	1.830	118.0	118.0
65-65.5	0.500	0.19875	0.0155	1.830	118.0	
65.5-66	0.500	0.19875	0.0155	1.992	128.4	126.6
66-66.5	0.500	0.19875	0.0155	2.068	133.3	

4.4 Pressuremeter Testing

Pressuremeter tests (PMT) were performed at the subject site by InSitu Tech Inc. on July 28th and 29th, 2010. There were two different probes used during the testing. The first was a TEXAM LNX-Vulcolan+75′ and the second a TEXAM LNX-Vulcolan+135′. InSitu Tech performed the corresponding membrane and system compressibility calibration tests for both probes used. Both probes have membrane sections that measured 1.44 in. in diameter and 18.11 in. in length with an initial volume of 117.47 in^3. The pressuremeter system setup including the probe, hydraulic line, and control box is presented in Fig. 4-2. A second PMT probe was used at the Tremonton site because the first was damaged by cobbles and gravels during the third test (Test 14) as shown in Fig. 4-3. Pressuremeter tests were completed at depths of 5 ft, 14.5 ft, 29 ft, 42.8 ft, and 57.5 ft. The PMT results for the Tremonton site are presented in Fig. 4-4 through Fig. 4-8 and the calculated engineering properties from InSitu Tech are given in Table 4-6. P_L^* is the net limit pressure, E_o is the initial soil modulus, and E_r is the reload soil modulus.

The soil conditions at the site consisted of clayey gravel with layers of very stiff to hard clay and silt with occasional gravel lenses. Most of the gravel encountered during drilling was fine gravel that contained sufficient clay and silt particles to stabilize the borehole wall. An exception was the interval from 22 ft to 26 ft, where the borehole collapsed after the drill bit was removed but before the PMT could be lowered into the borehole. This collapse indicates a gravelly zone in the interval that lacked sufficient cohesive fines to stabilize the borehole.

Fig. 4-2. Pressuremeter test setup at the Tremonton site

Fig. 4-3. Damage done to the PMT probe at a depth of 14.5 ft at the Tremonton site

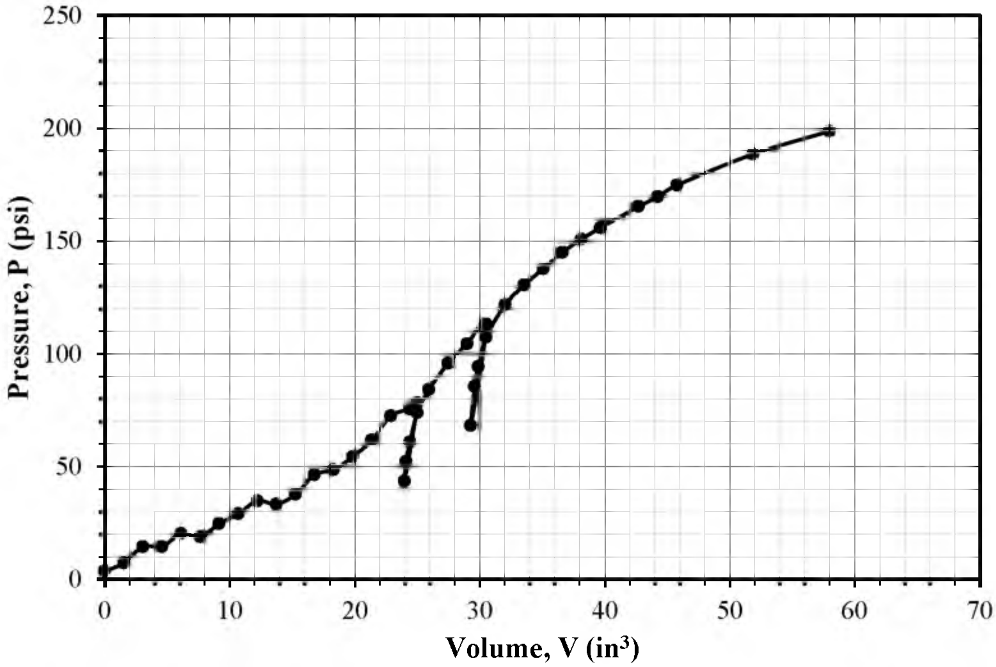

Fig. 4-4. Corrected PMT results at a depth of 5.0 ft for the Tremonton site (adapted from Smith, 2010)

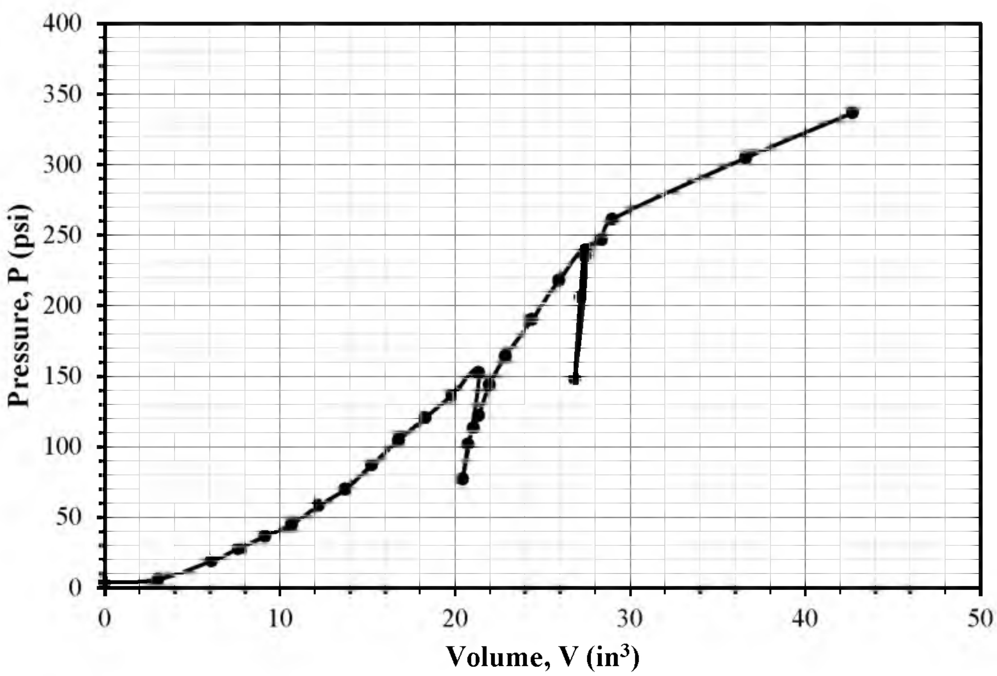

Fig. 4-5. Corrected PMT results at a depth of 14.5 ft for the Tremonton site (adapted from Smith, 2010)

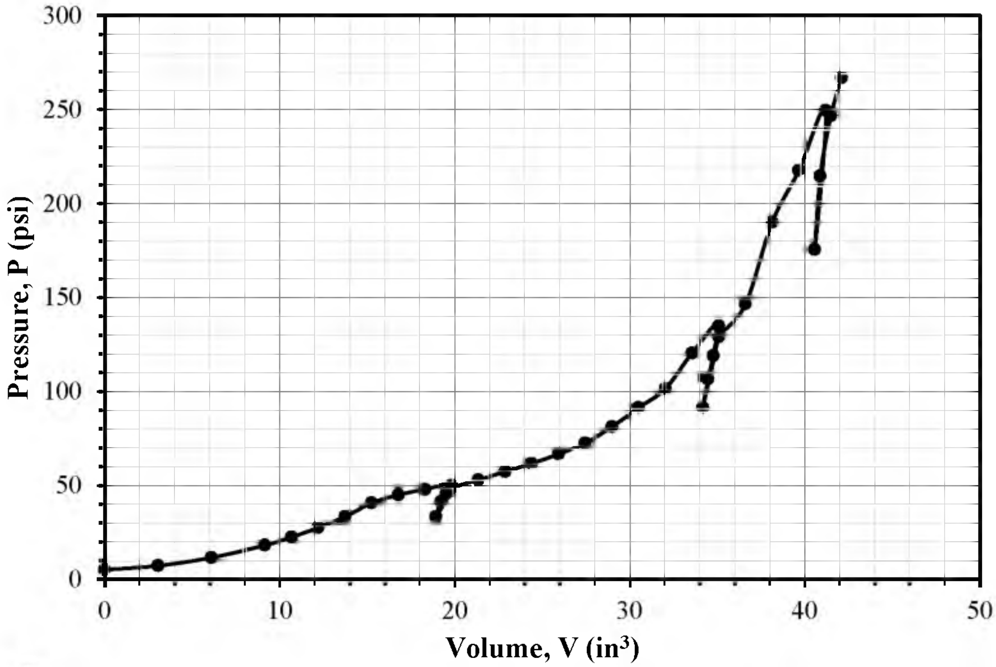

Fig. 4-6. Corrected PMT results at a depth of 29.0 ft for the Tremonton site (adapted from Smith, 2010)

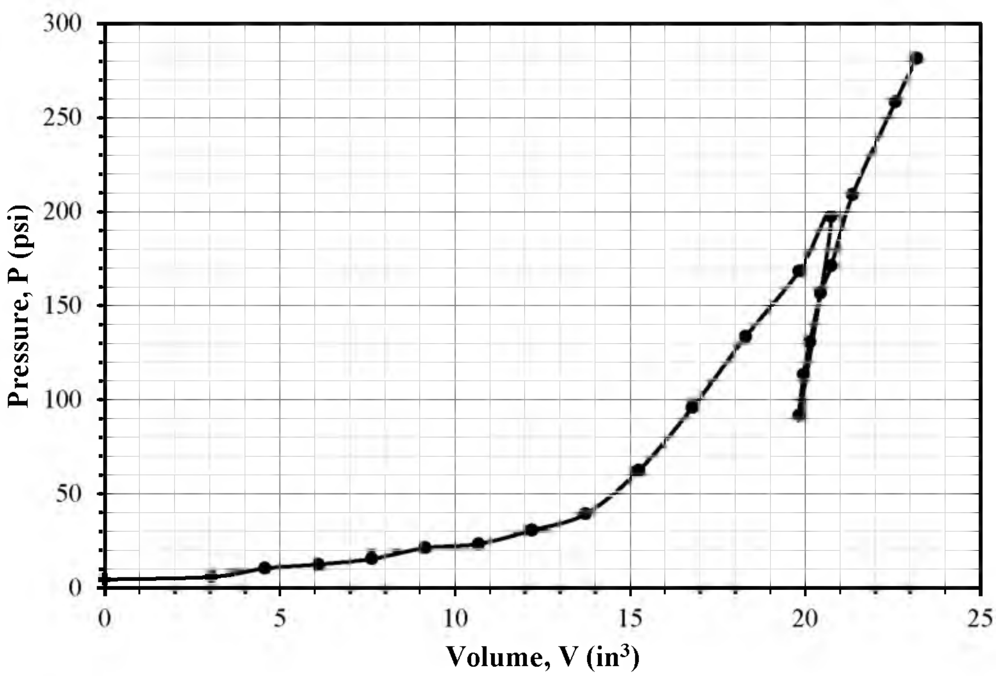

Fig. 4-7. Corrected PMT results at a depth of 42.8 ft for the Tremonton site (adapted from Smith, 2010)

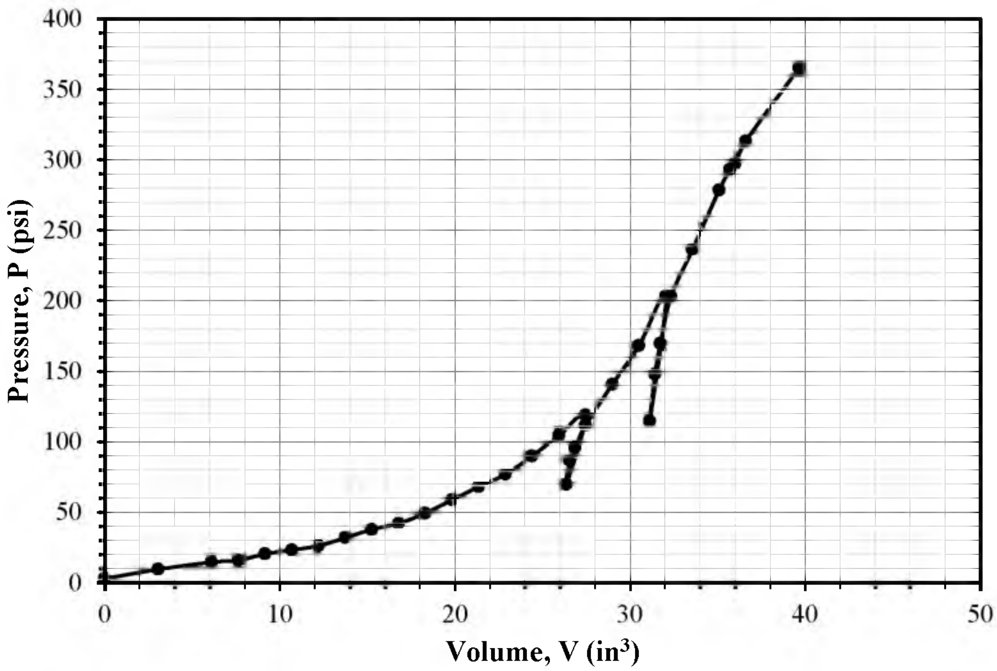

Fig. 4-8. Corrected PMT results at a depth of 57.5 ft for the Tremonton site (adapted from Smith, 2010)

Table 4-6. Pressuremeter Test Results and Properties for Tremonton Site (adapted from Smith 2010)

Test No.	Depth (ft)	E_o (ksf)	E_r (ksf)	P_L* (ksf)	E_o/P_L*
12	5.0	390	1710	29.4	13.2
13	14.5	860	3300	63	13.6
14	29.0	1030	2230	> 75	< 12
15	42.75	1950	4200	> 75	< 12
17	57.5	1650	4075	> 75	< 12

4.5 Becker Penetration Testing

On April 12, 2011, Becker penetration tests (BPTs) were conducted at the subject site by Great West Drilling. The historical development and procedure of the Becker hammer drill are provided in Harder and Seed (1986) and also in Sy and Campanella (1993). A representative of GRL Engineers, Inc was also present to obtain dynamic measurements during the BPT testing, to calculate the energy transfer from the hammer to the Becker drill casing, and estimate the soil resistance acting along the shaft of the drill casing.

BPT tests were completed using an AP 1000 Becker hammer (Fig. 4-9). A 6-5/8" O.D. Becker hammer casing was used along with a 6-5/8" 8 tooth crowed out type closed drilling bit (Fig. 4-10). The drill used a Link Belt 180 double-acting diesel pile hammer with a ram weight of 1.73 kips and a rated energy of 8.1 kip-ft to drive a specially designed double wall casing into the ground. Blow counts and peak bounce chamber pressures were recorded for each 1 ft of penetration into the soil (Fig. 4-11). A photo of the bounce chamber pressure guage used is presented in Fig. 4-12.

Dynamic measurements were obtained using two accelerometers and two strain transducers bolted to a 2 ft long section of drill rod attached to the top of the drill string during driving (Fig. 4-13). A Model PAK Pile Driving Analyzer® (PDA) was used to digitize, store, and process the data from the accelerometers and transducers (Fig. 4-14). Average case method results for each 1 ft of penetration are presented in Table 4-7. These results include Becker penetration blow counts (BLC), maximum transferred energy (EMX), energy transfer ratio (ETR), maximum force (FMX), maximum velocity (VMX), total skin friction (SFT), and total soil resistance (RTL).

Fig. 4-9. Becker hammer drill rig

Fig. 4-10. Closed-ended 6-5/8 in. Becker hammer drill bit

Fig. 4-11. Becker hammer casing marked at 1 ft intervals

Fig. 4-12. Bounce chamber pressure guage for BPT

Fig. 4-13. Attached accelerometers and transducers for dynamic measurements

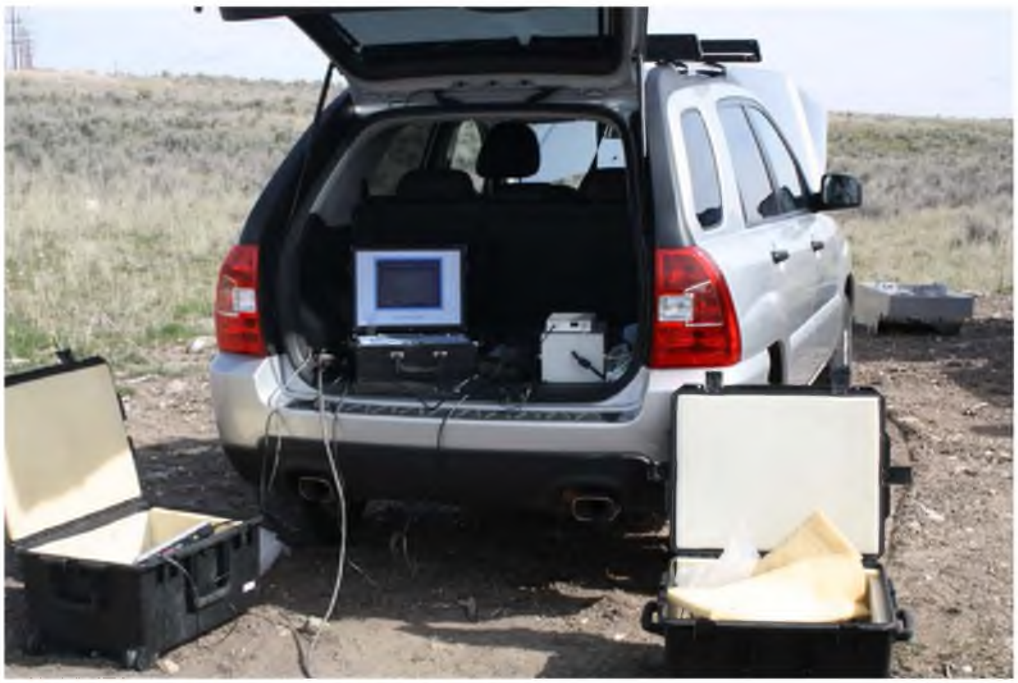

Fig. 4-14. GRL's mobile setup for processing and analyzing dynamic measurements

Table 4-7. Becker Hammer Case Method Results

Depth (ft)	*BLC* (bl/ft)	*EMX* (k-ft)	*ETR* (%)	*FMX* (kips)	*VMX* (ft/s)	*BPM* (bl/min)	*SFT* (kips)	*RTL* (kips)
3	11	1.9	24	64	6.4	98	0	23
4	22	2.3	28	123	6.8	94	1	58
5	30	2.2	28	131	7.4	94	6	60
6	33	2.7	34	162	9.1	93	17	74
7	33	3.5	43	195	10.3	92	31	91
8	32	3.7	46	197	10.9	92	39	84
9	35	2.9	36	180	9.1	92	37	109
10	36	3.1	38	189	9.4	92	40	124
11	44	3.1	38	199	10.0	92	51	145
12	54	3.0	37	203	10.2	92	49	152
13	62	3.2	39	217	11.0	92	59	169
14	56	3.2	39	212	10.8	92	66	157
15	54	3.1	38	206	10.3	92	63	151
16	65	3.2	40	217	11.0	92	84	165
17	79	3.3	41	227	11.6	92	93	186
18	102	3.5	43	244	12.2	92	105	208
19	131	3.3	40	242	12.3	92	113	221
20	117	3.1	38	241	12.2	92	134	227
21	96	3.2	40	224	12.1	92	178	258
22	60	3.6	44	235	12.5	92	164	225
23	53	3.6	44	228	12.1	92	158	216
24	76	3.7	45	238	12.7	92	166	237
25	126	3.7	45	247	13.4	93	172	272
26	233	3.5	43	244	13.3	92	172	290
27	181	3.5	43	245	13.4	92	184	295
28	226	3.4	42	243	13.1	93	195	305
29	552	3.4	41	243	13.1	93	211	337
30	946	3.0	37	261	12.1	93	246	337

Two CAPWAP (CAse Pile Wave Analysis Program) analyses were performed at depths of 15 ft and 30 ft. CAPWAP is a numerical analysis procedure which solves for soil resistance parameters and distribution using the measured force and velocity data as well as the wave equation, Rausche et al., (1985). The solution includes total static bearing capacity values as well as the shaft friction, end bearing, and other dynamic properties. The results of the two CAPWAPs performed are presented in Table 4-8.

Drilling was stopped at a depth of approximately 30 ft due to extremely high BPT blow count values near 1000 bl/ft, thus resulting in refusal. In addition, a pull-back test was performed at the 30 ft depth, which under ideal soil conditions provides the average calculated loads (adjusted for the Becker casing weight) at 1 in. displacement. The pull-back test resulted in a maximum load of 137 kips with just below 0.5 in. of vertical displacement.

4.6 Cone Penetration Testing

ConeTec™ conducted three cone penetration tests (CPTs) at the Tremonton site on May 11, 2011 (Fig. 4-15). Two of the soundings were performed using the standard cone with a diameter of 1.5 in. Refusal (i.e., rig capacity) was reached on the first two soundings (CPT-01 and CPT-02) at approximate depths of 28.0 ft and 33.5 ft, respectively. The third sounding (CPT-03) was conducted using a larger cone with a diameter of 3.0 in. (Fig. 4-16 and Fig. 4-17).

The initial thought for using this larger cone was that it would be able to push past the larger diameter particles in the soil profile more effectively that the smaller cone. This hypothesis was proved to be false since refusal was reached at a depth of 7.9 ft below the

Table 4-8. CAPWAP Results

		Ultimate Capacity		
Depth (ft)	Blow Count (bl/ft)	Total (kips)	Shaft (kips	Toe (kips)
15	54	115	32	83
30	946	227	187	40

surface. The results from each of these soundings are presented in Fig. 4-18 through Fig. 4-20. The results are given as the total cone tip resistance, q_t, the sleeve friction resistance, f_s, the cone pore water pressure, u, the friction ratio, R_f, and the soil behavior type, *SBT* (Lunne et al., 1997). Pore pressure dissipation tests (PPDs) from CPT-01 and CPT-02 are presented in Fig. 4-21 through Fig. 4-23.

4.7 Summary

This chapter describes the details of the various methods of geotechnical field investigation that were conducted at the project site. In all, four site visits were made to obtain soil sampling, subsurface profiling, and in-situ testing for strength and deformation characteristics of the subsurface material. During the sonic drilling method, SPT blow counts were obtained for every 2.5 ft of drilling as well as continuous bulk sampling. Pressuremeter tests were performed to a depth of 60 ft to obtain in-situ data representing the soil strength and lateral deformation versus displacement behavior. Becker hammer tests were performed in a continuous effort to get useable blow count information on the material for engineering design. Three cone penetration soundings were also performed as another method to obtain soil strength information for engineering design. Detailed data reduction of the results obtained from the

Fig. 4-15. ConeTec CPT drill rig

Fig. 4-16. Comparison of 1.5 in. and 3.0 in. CPT cones

Fig. 4-17. 3.0 in. cone penetration probe

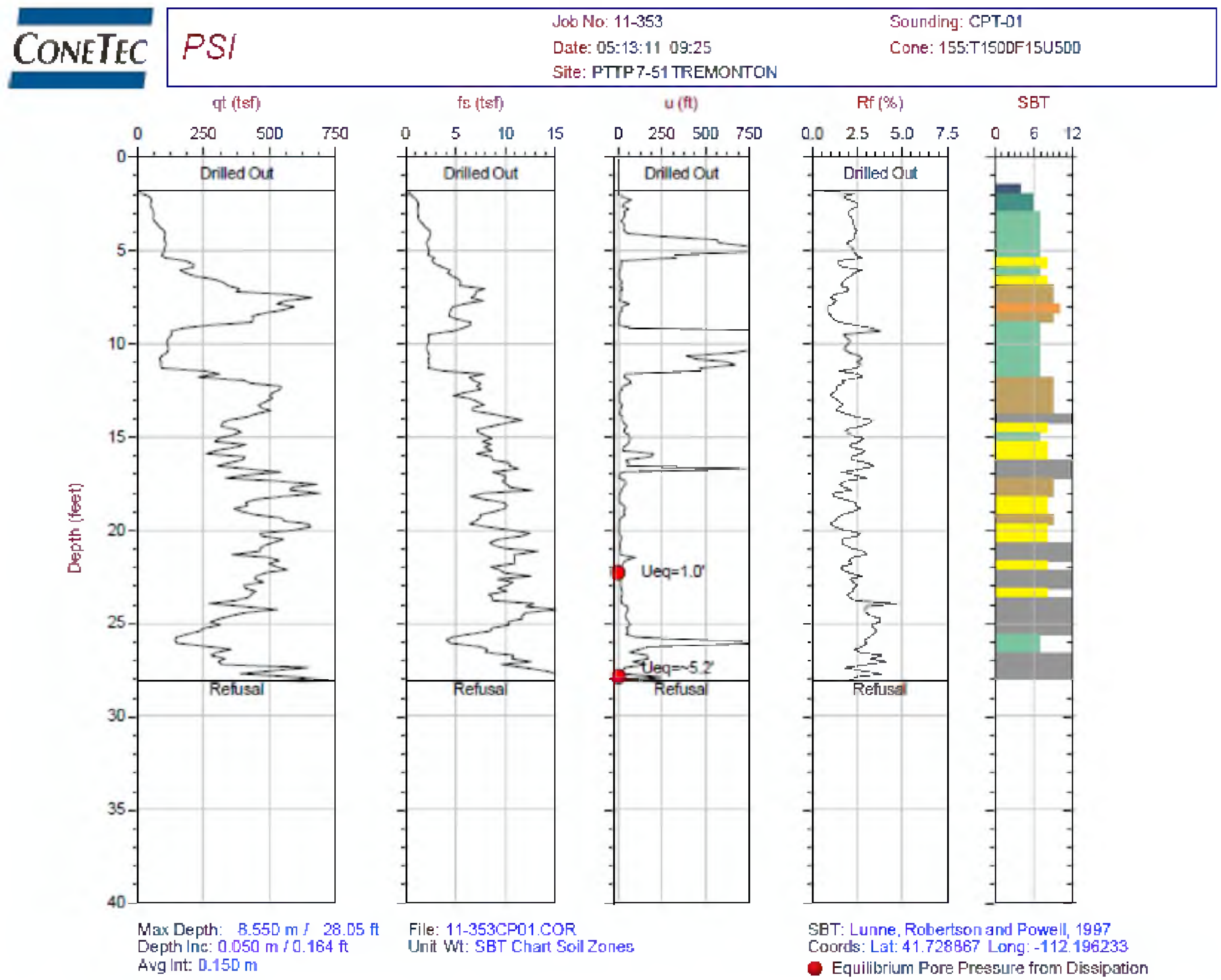

Fig. 4-18. Log for sounding CPT-01 conducted at the Tremonton site

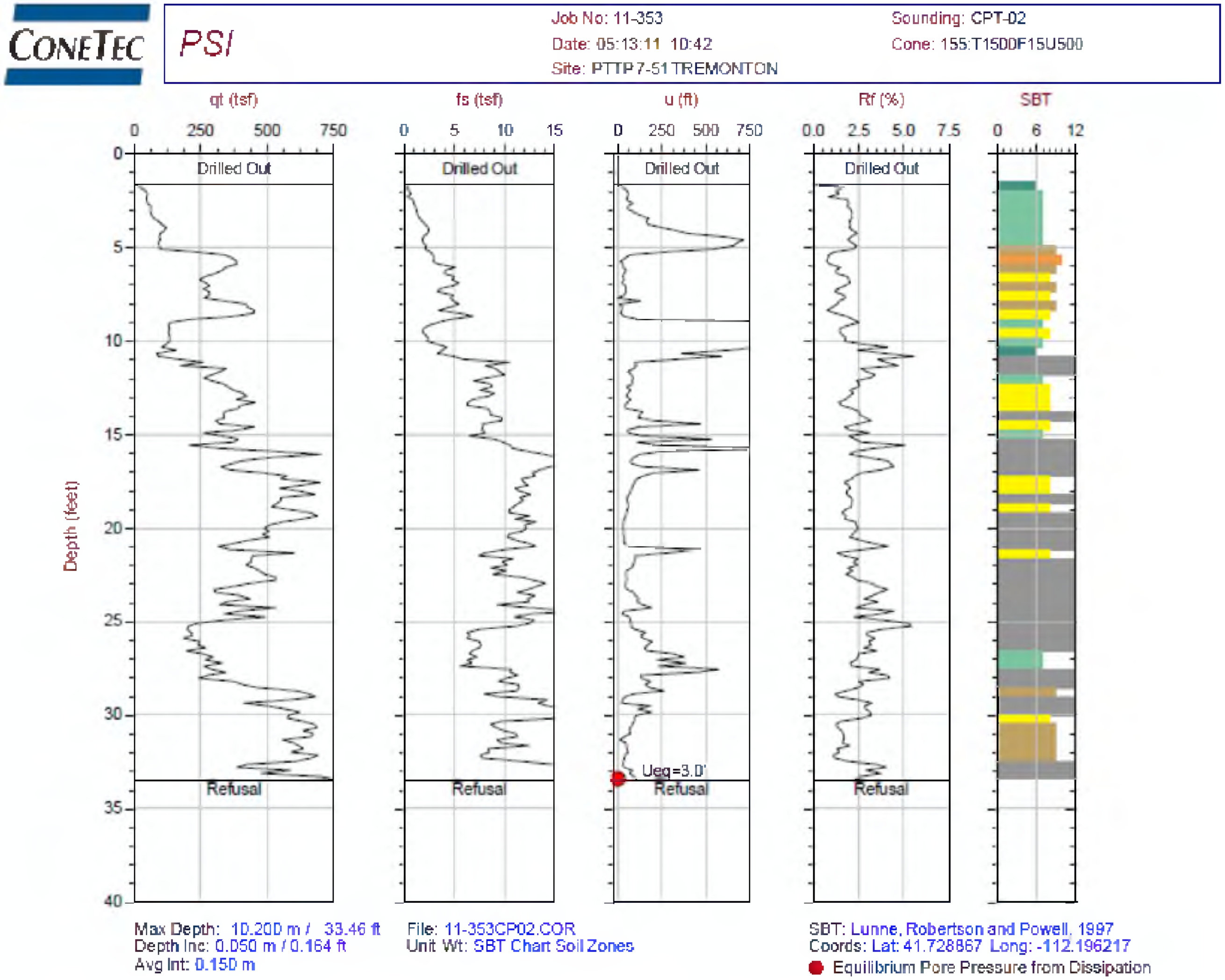

Fig. 4-19. Log for sounding CPT-02 conducted at the Tremonton site

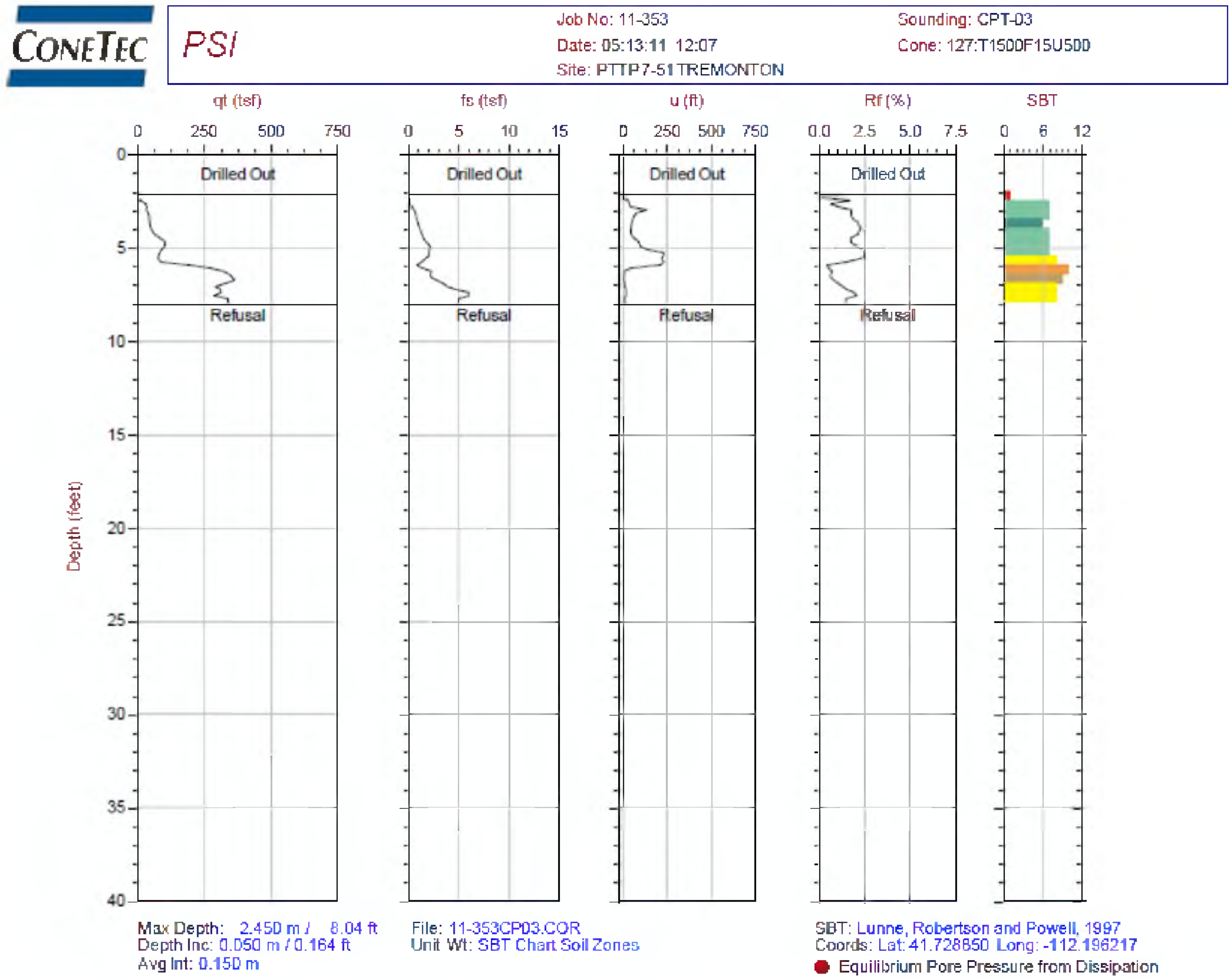

Fig. 4-20. Log for sounding CPT-03 conducted at the Tremonton site

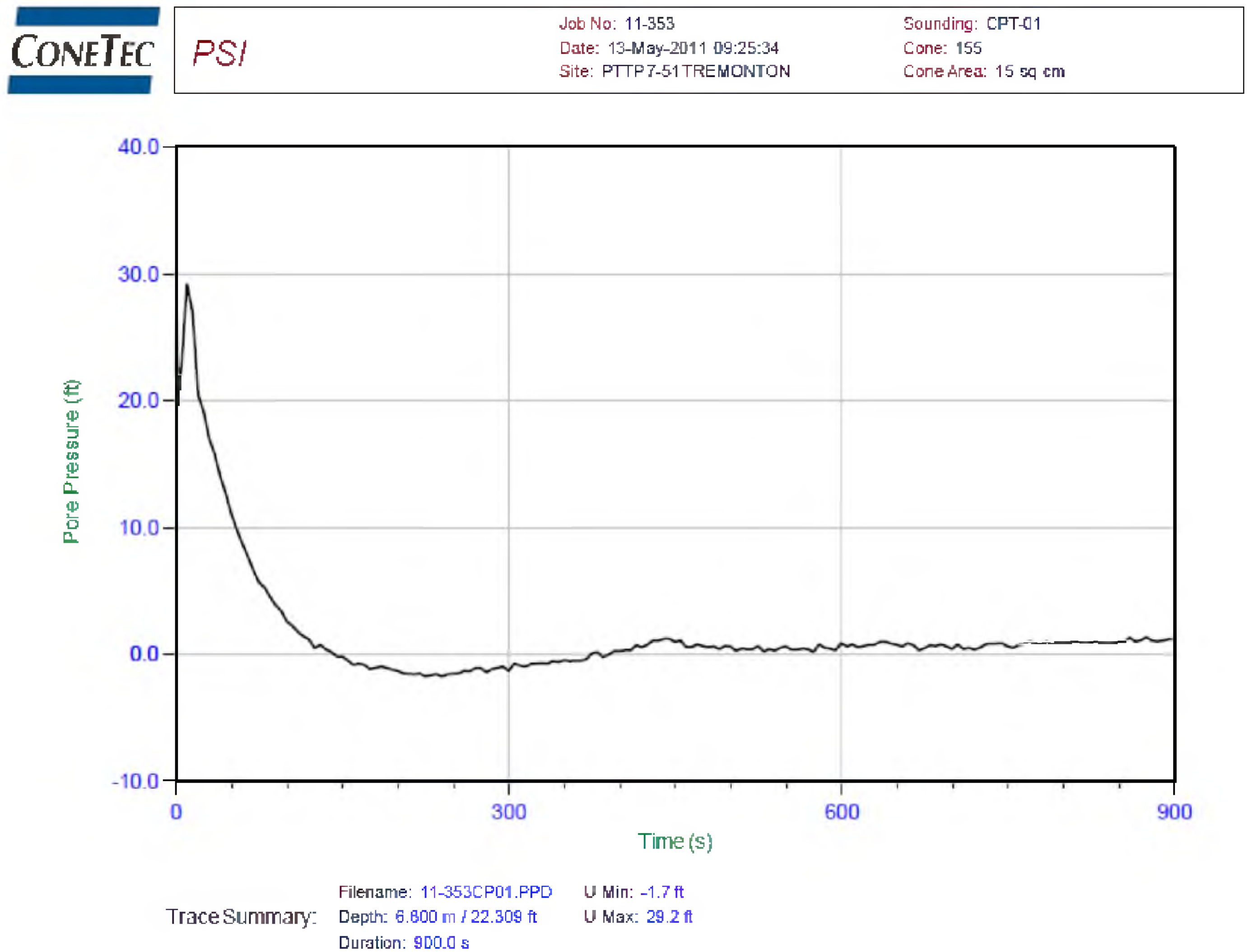

Fig. 4-21. PPD results from CPT-01 at a depth of 22.3 ft

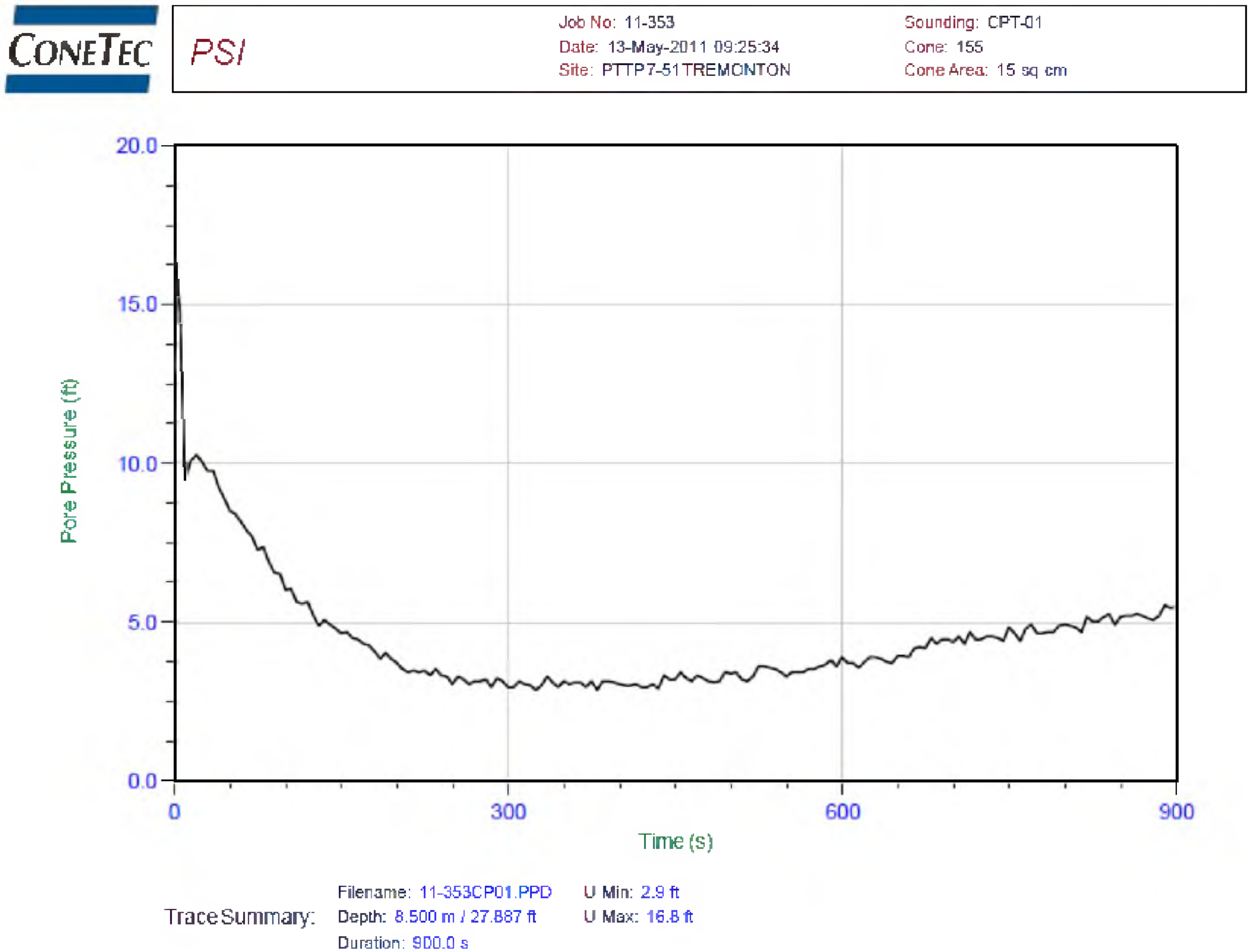

Fig. 4-22. PPD results from CPT-01 at a depth of 27.9 ft

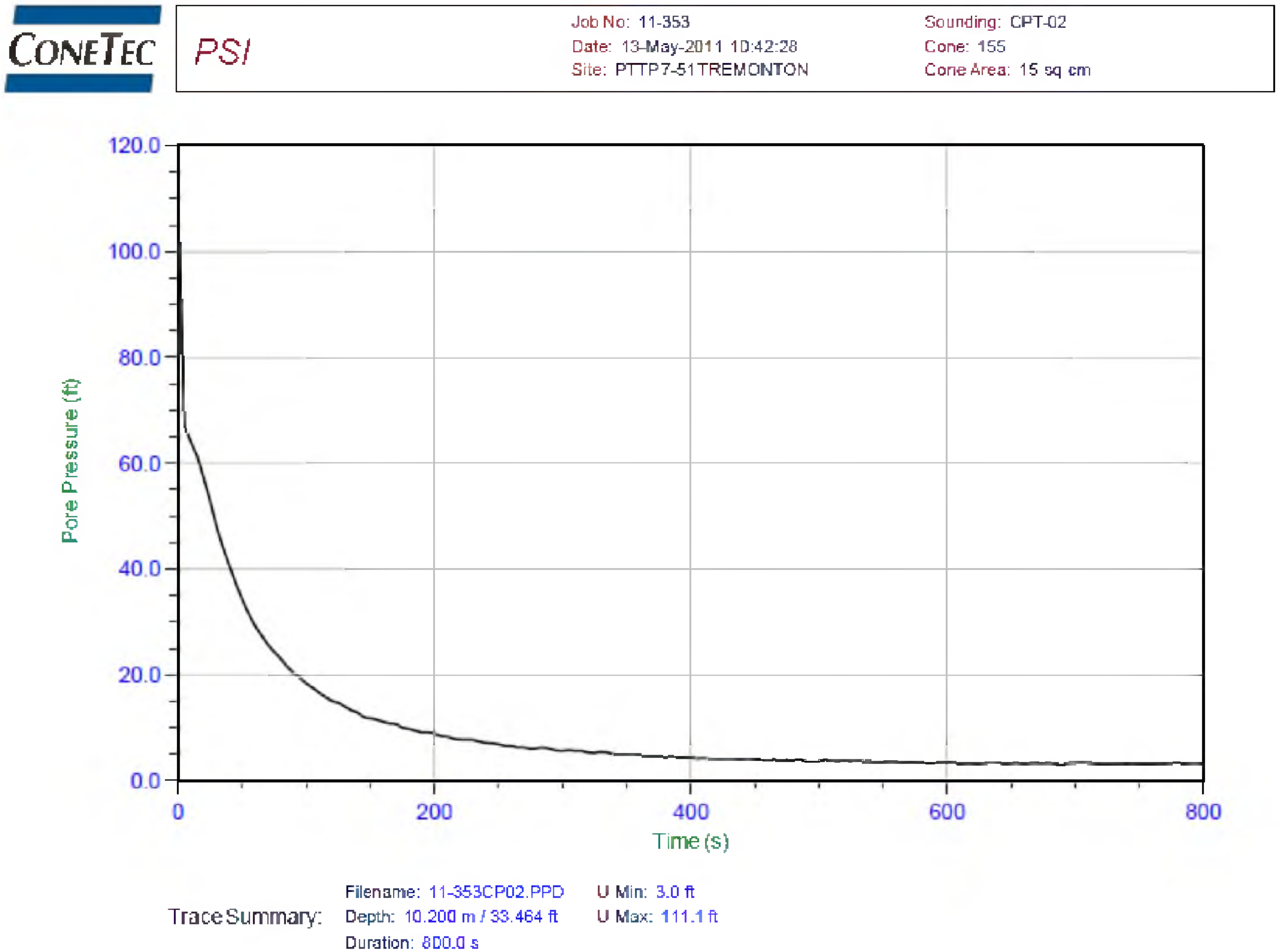

Fig. 4-23. PPD results from CPT-02 at a depth of 33.5 ft

pressuremeter tests, the cone penetration tests, and the Becker penetration tests are provided in subsequent chapters of this report.

5 LABORATORY INVESTIGATION

5.1 Overview

A laboratory investigation for the Tremonton project site was performed on the soil samples obtained during the field investigations. The purpose of this investigation was to characterize the in-situ conditions and shear strength properties of the subsurface materials. The soil samples that were collected from the field investigations included continuous bulk samples and split spoon samples from the sonic drilling as well as bulk samples that were taken from the separate field investigation to determine the unit weight. Soil properties were evaluated at 2.5 ft intervals from the bulk samples. These properties included: water content determinations, particle size, and Atterberg limit analyses. Small diameter (2.8 in.), isotropically consolidated, drained, axial compression (CIDC) triaxial tests as well as large (6 in.) and small diameter, isotropically consolidated, undrained axial compression (CIUC) triaxial tests were conducted on scalped and on reconstituted specimens using the soil obtained from sonic drilling. These specimens were used to obtain shear strength properties of the subsurface materials.

This chapter discusses the various index and shear strength tests conducted during the laboratory investigation. Tests were conducted using the American Society of Testing and Materials (ASTM) standards as a reference for procedure. Tabular results of the laboratory tests are presented in this chapter; however, a more detailed description of the interpretation of the engineering design and laboratory data versus depth profiles are presented in Chapter 6.

5.2 Triaxial Compression Testing

Triaxial compression tests were performed at the geotechnical and structural laboratories at The University of Utah. All tests were conducted following the procedures of the (ASTM D4767) for disturbed samples using the wet mounting method.

5.2.1 2.8 in. Diameter Specimens

CIDC tests were conducted on scalped and reconstituted specimens using soil obtained from the sonic drilling at the Tremonton site. The 2.8 in. diameter triaxial test set up was comprised of a Geocomp™ load frame, a linear velocity displacement transducer (LVDT) that was used to measure axial displacements and Flowtrac™ pumps that were used to regulate and measure the pore pressures within the specimen and any corresponding volume change that occurred within the surrounding fluid-filled cell (Fig. 5-1). Prior to reconstituting the samples, particles of 0.5 in. diameter, or greater, were removed using a soil sieve. Water was added to the specimens to bring them to their in-situ moisture content, and the specimens were reconstituted (i.e., compacted) in 1 in. lift increments to their in-situ soil density.

The upper three soil samples obtained from the soil profile at the Tremonton site were consolidated to confining pressures that corresponded to in situ vertical effective stress at depths: 2.5 ft, 5.0 ft, and 14.5 ft, respectively and were subsequently tested in unsaturated conditions. The soil at a depth of 2.5 ft was granular with a peak effective friction angle, ϕ'_p = 41°. Based on the results, it was noted that the values of ϕ'_p

Fig. 5-1. Triaxial compression test set up

decreased at depths below 14.5 ft where higher confining stresses were used in the testing program.

This decrease in ϕ'_p was expected for dilative soils tested at high confining stresses. However, it should be noted that the soils tested from the lower depths in the soil profile are transitional materials, in that they exhibit neither purely granular nor cohesive behavior. These soils had a relatively high initial degree of saturation (about 80%), and the test results at the differing confining pressures were inconsistent. It is possible that at the relatively high deformation rate used for the tests, the samples exhibited a drainage state that was somewhere between drained and undrained behavior.

Because the degrees of saturation were high (greater than 80%) and fairly high fines contents were measured throughout most of the soil profile, a decision was made to change from performing CIDC tests to CIUC tests for depths corresponding to 5.0 ft, 14.5 ft, 29.0 ft, 42.8 ft, and 57.5 ft at the Tremonton site. Samples from these depths were selected so as to: (a) correspond with possible range of drilled shaft depths, and (b) compare the CIUC test results with the PMT results at the corresponding PMT intervals. As was done with the CIDC tests, the CIUC tests were reconstituted to their in situ unit weight and water content after scalping larger material. The samples were then back-pressure saturated and consolidated at a confining stress that corresponded to the in situ effective vertical stress. Plots of deviator stress versus axial strain are presented in Fig. 5-2 through Fig. 5-6 for each of the testing depths. The CIUC tests made it possible to get estimates of undrained shear strength s_u, effective peak friction angle $\phi'_{p,tc}$, and a large-strain friction angle $\phi'_{LS,tc}$ from one test. The results of the pertinent triaxial tests are presented in Table 5-1.

5.2.2 6 in. Diameter Specimens

Larger diameter (i.e., 6 in. diameter) isotropically consolidated, undrained, axial compression (CIUC) triaxial tests were also conducted on scalped and reconstituted specimens using soil obtained from sonic drilling. The specimens were reconstituted to their in-situ unit weight and water content using the same procedure as the 2.8 in. diameter samples, with the exception that larger diameter particles up to 1 in. in diameter were left within the sample (Fig. 5-7). The same Flowtrac™ pumps used in the testing procedure as the 2.8 in. diameter samples were used to measure pore water pressure and volume change. Due to the increase in volume of the cell and respective volume displacement during testing, a separate larger capacity pump was also used to maintain

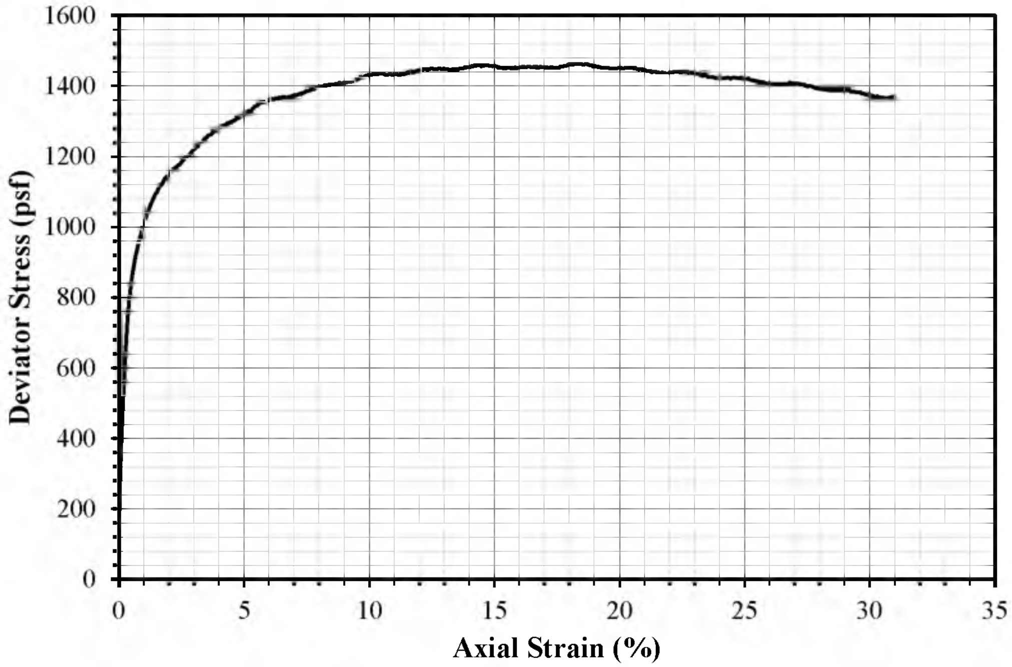

Fig. 5-2. Deviator stress versus axial strain 2.8 in. diameter triaxial compression results for sample taken at a depth of 5 ft

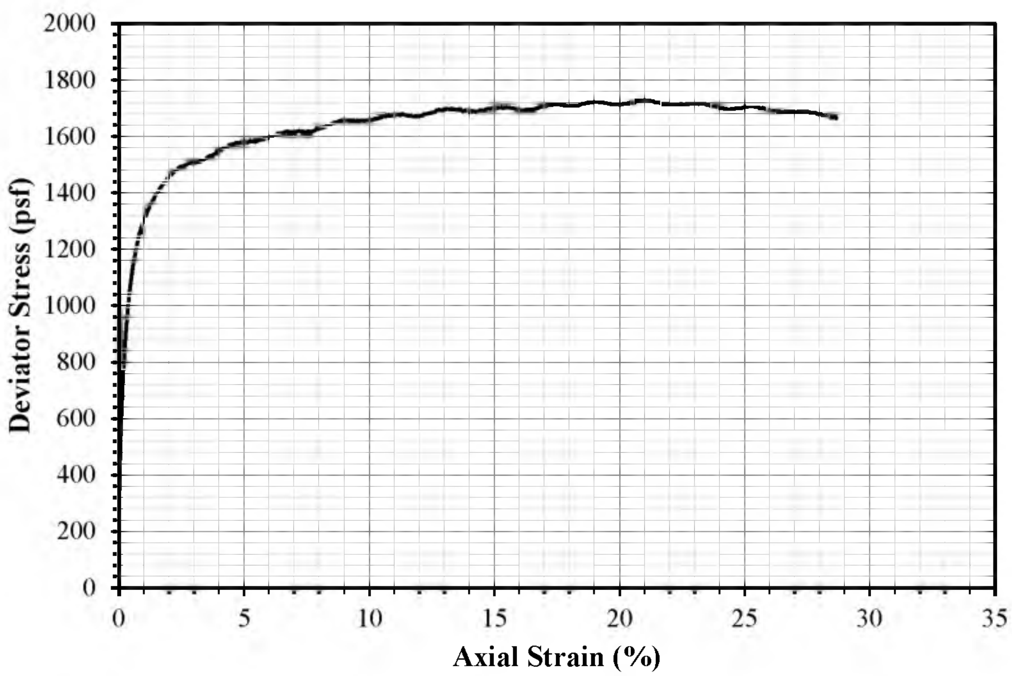

Fig. 5-3. Deviator stress versus axial strain 2.8 in. diameter triaxial compression results for sample taken at a depth of 14.5 ft

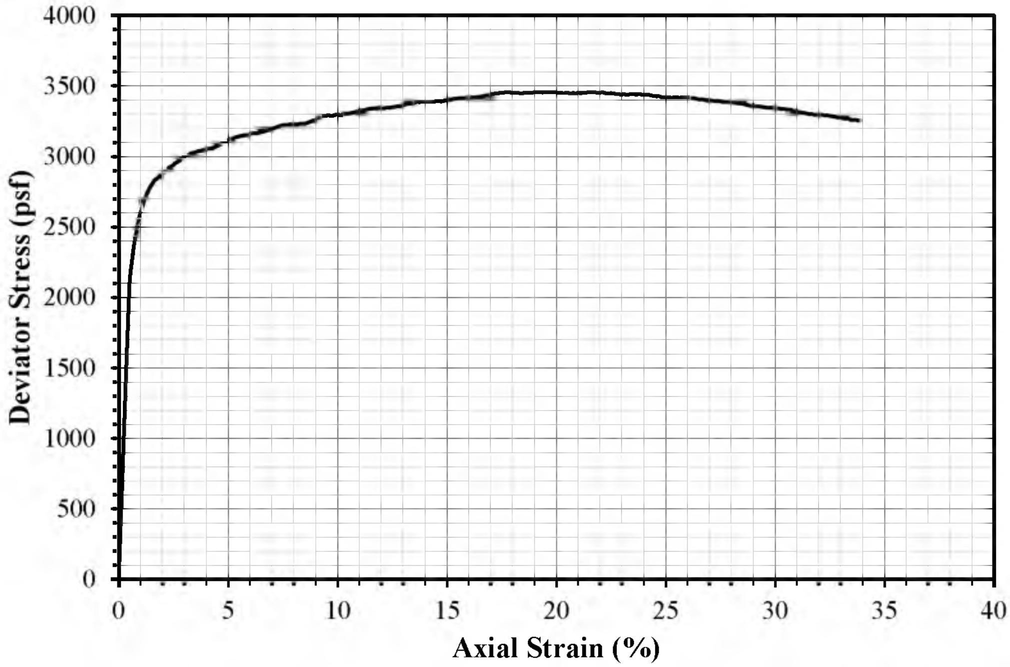

Fig. 5-4. Deviator stress versus axial strain 2.8 in. diameter triaxial compression results for sample taken at a depth of 29 ft

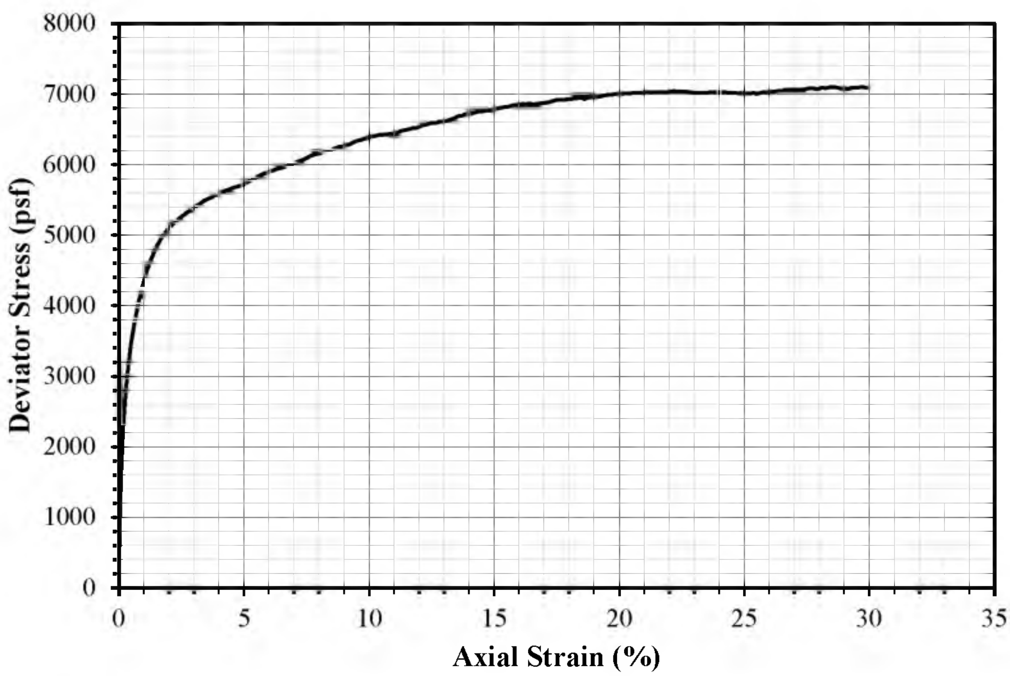

Fig. 5-5. Deviator stress versus axial strain 2.8 in. diameter triaxial compression results for sample taken at a depth of 42.8 ft

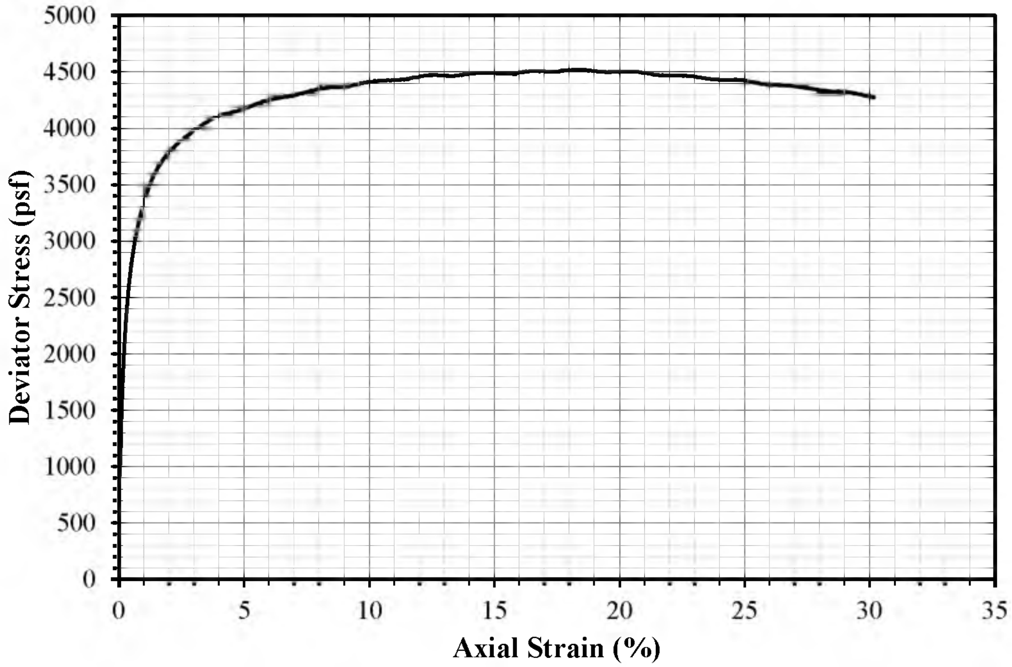

Fig. 5-6. Deviator stress versus axial strain 2.8 in. diameter triaxial compression results for sample taken at a depth of 57.5 ft

Table 5-1. Shear Strength Properties from 2.8 in. CIUC Triaxial Tests for Tremonton Site

Depth (ft)	$\phi'_{p,tc}$ (deg)	$\phi'_{LS,tc}$ (deg)	s_u (psi)
2.5	41	30	N/A
5.0	66	47	5.1
14.5	60	60	6.0
29	36	35	12
42.5	42	38	25
57.5	28	28	16

Fig. 5-7. Remolded 6 in. triaxial sample

radial (in-situ) pressure within the triaxial cell surrounding the specimen. Because of their size, the 6 in. diameter tests were set up in the structures bay at The University of Utah utilizing a higher capacity load frame and load cell in order to compress the larger diameter samples. Values of load and deformation during the tests were recorded simultaneously with the pressure and volume change. The set up of the triaxial compression test system is presented in Fig. 5-8 and Fig. 5-9.

A height comparison of the sample mold used to reconstitute the specimens and a deformed sample is presented in Fig. 5-10. The larger diameter tests were completed

Fig. 5-8. 6 in. triaxial test setup

Fig. 5-9. Loading frame used for 6 in. trixial tests

Fig. 5-10. Comparison of 6 in. sample mold and deformed sample

using samples obtained from depths of 5.0 ft, 14.5 ft, 29.0 ft, 42.8 ft, and 57.5 ft, respectively, which correspond to the same depths used in the smaller diameter testing. Plots of deviator stress versus axial strain are presented in Fig. 5-11 through Fig. 5-15 for each of the 6 in. diameter trixial tests. Results from the 6 in. (CIUC) tests gave estimates of the undrained shear strength s_u and of the effective peak internal friction angle ϕ'_p, which are also presented in Table 5-2.

5.3 Water Content Determination

Water content was determined for each 2.5 ft long sample bag obtained from the drilling and for each of the split spoon samples. In addition, water contents were determined from samples taken during field work performed on September 21, 2010. The reconstituted samples for triaxial testing were reconstituted to water contents corresponding to the values obtained from these determinations.

5.4 Particle Size Analysis

A particle size analysis was performed for each 2.5 ft long sample bag obtained from the sonic drilling. The analysis was done in accordance with ASTM D2487, making use of a 152H type hydrometer for analysis of the smaller particles. Grain size distribution curves were then developed from each particle size analysis. Using the Unified Soil Classification System (USCS), values of percent gravel, percent sands, and percent fines were determined from each sample. Individual grain size distribution (GSD) curves for each sample taken at the Tremonton site are provided in Appendix A.

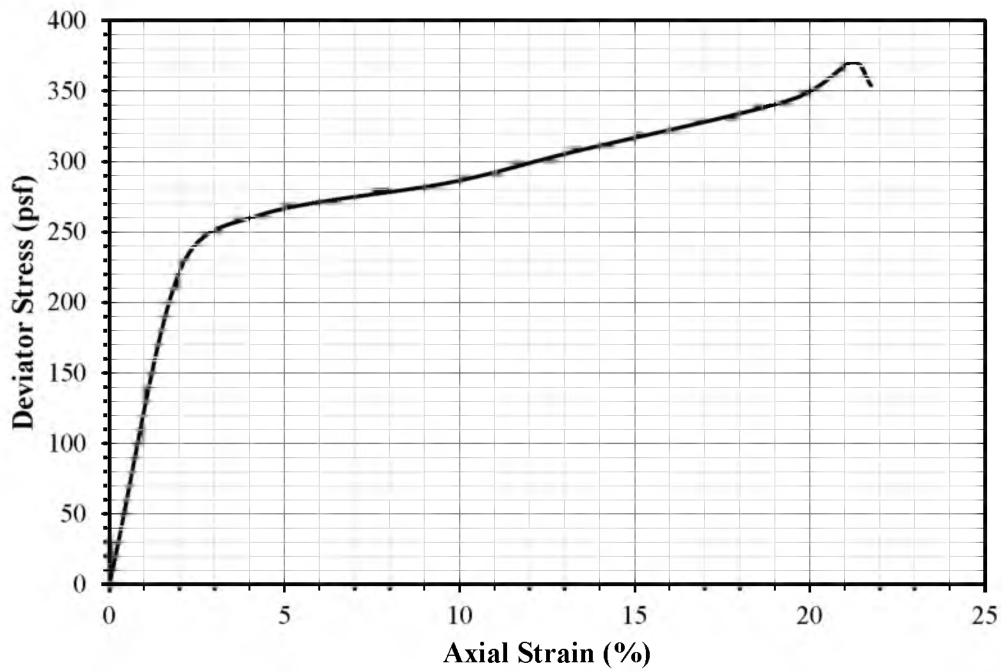

Fig. 5-11. Deviator stress versus axial strain 6 in. diameter triaxial compression results for sample taken at a depth of 5 ft

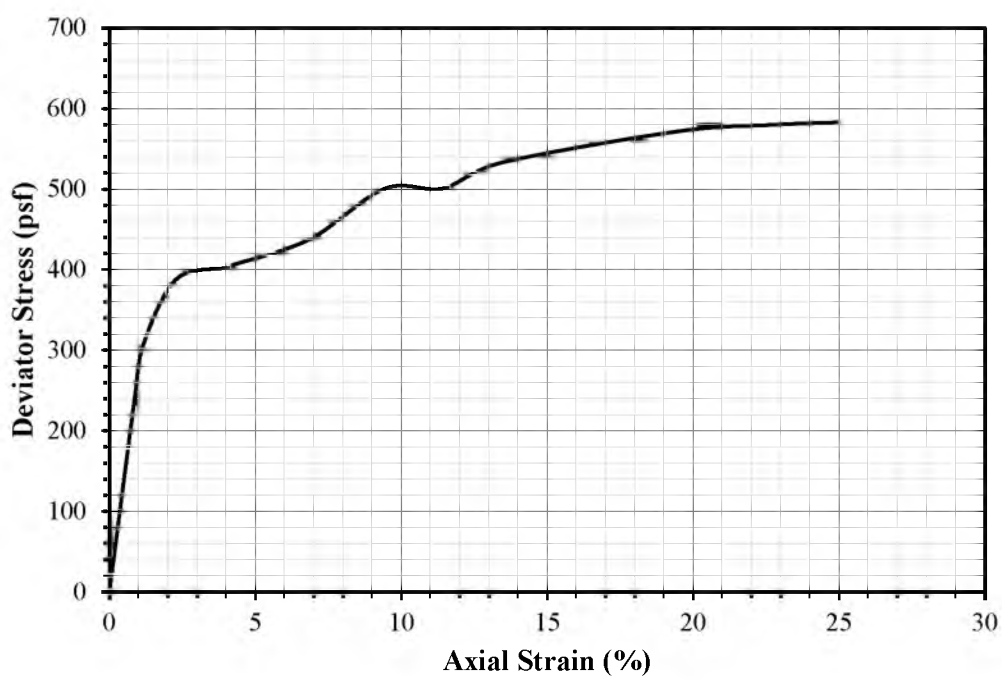

Fig. 5-12. Deviator stress versus axial strain 6 in. diameter triaxial compression results for sample taken at a depth of 14.5 ft

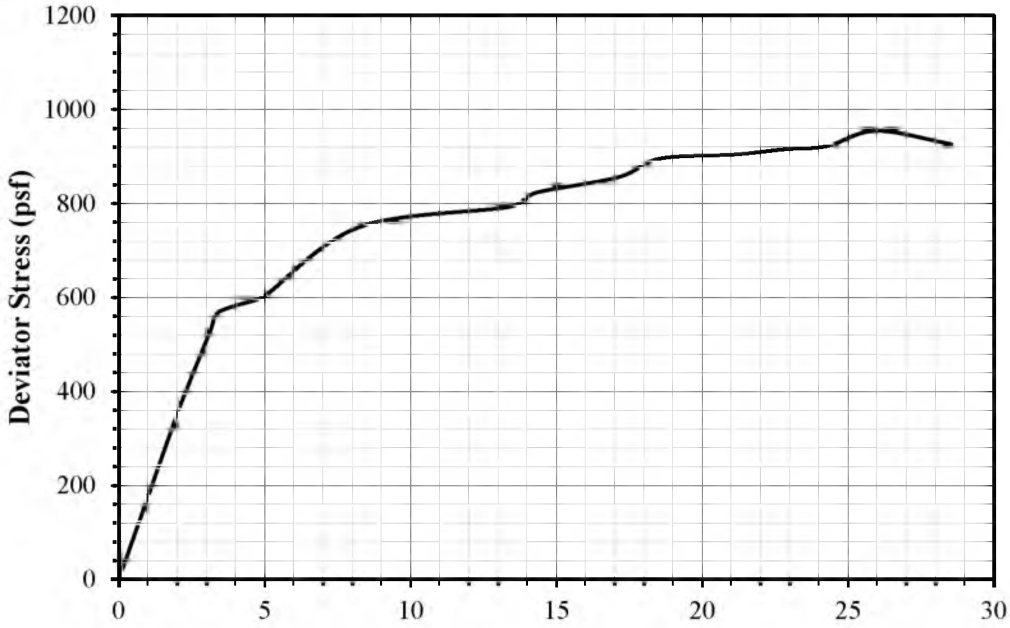

Fig. 5-13. Deviator stress versus axial strain 6 in. diameter triaxial compression results for sample taken at a depth of 29 ft

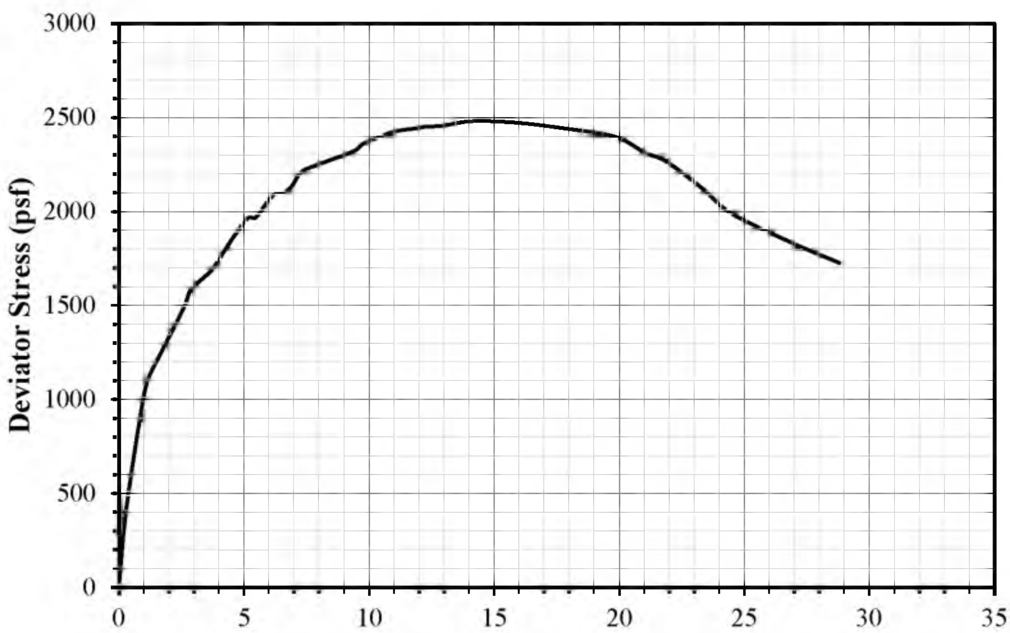

Fig. 5-14. Deviator stress versus axial strain 6 in. diameter triaxial compression results for sample taken at a depth of 42.8 ft

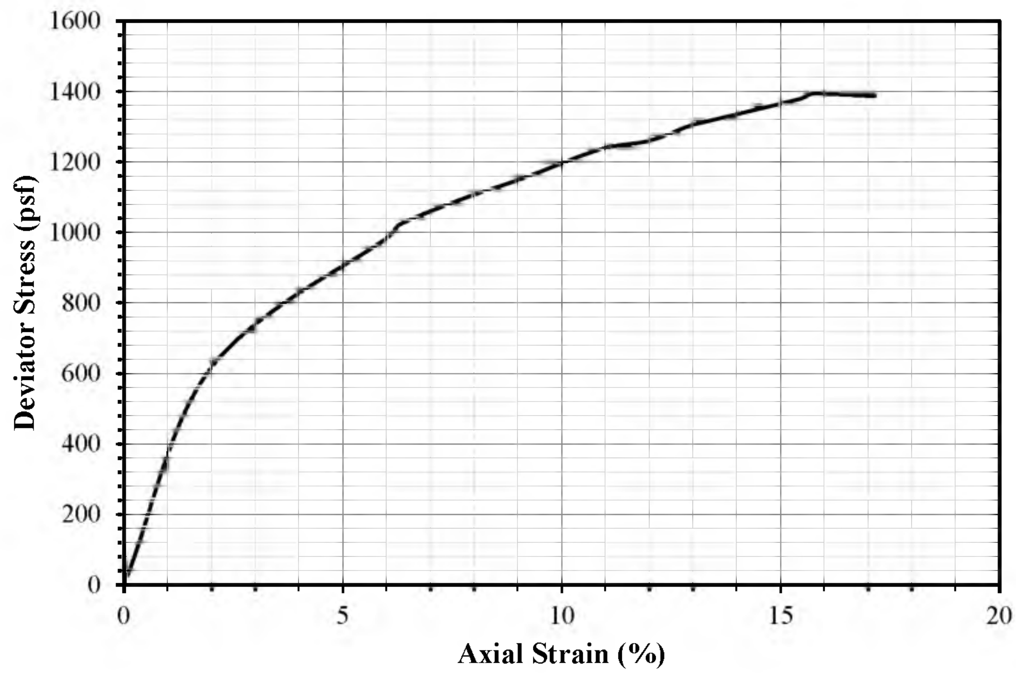

Fig. 5-15. Deviator stress versus axial strain 6 in. diameter triaxial compression results for sample taken at a depth of 57.5 ft

Table 5-2. Shear Strength Properties from 6 in. CIUC Triaxial Tests for Tremonton Site

Depth (ft)	$\phi'_{p,tc}$ (deg)	s_u (psi)
5.0	21	2.0
14.5	22	2.0
29	35	3.3
42.5	27	8.6
57.5	45	4.8

5.5 Atterberg Testing

Atterberg limit tests were also conducted on each 2.5 ft long sample bag obtained from sonic drilling. These tests were completed in order to define the Atterberg limits of the soil (i.e., plastic and liquid limit). The results of the Atterberg limit tests were used in conjunction with the particle size analyses to classify each sample bag in accordance with ASTM D2487.

5.6 Summary

Chapter 5 provided details of the laboratory investigations that were carried out using the samples collected during the field investigations described in Chapter 4. Laboratory testing include in-situ moisture content, particle size analysis, Atterberg limit testing, and large and small diameter consolidated isotropically drained and undrained axial compression tests.

6 FIELD AND LABORATORY DATA REDUCTION

6.1 Overview

This chapter will go over in detail the data reduction of the field and laboratory investigations that were performed and described in Chapter 4 and Chapter 5. Data reductions are performed to obtain strength parameters of the subsurface soils to be utilized in engineering design. Boring logs from the field investigation are provided in this chapter along with plots of engineering properties determined from the laboratory investigation vsersus depth. Strength parameters are determined from the large and small triaxial tests, the cone penetration testing (CPT) data, and the Becker hammer penetration testing (BPT) data. The pressuremeter reduction is utilized to develop the load-displacement (*P*-*y*) curves. Comparisons of the strength parameters and *P*-*y* curves are described in later chapters.

6.2 Subsurface Profiles

Subsurface materials and conditions were logged versus depth and are presented as boring logs (Fig. 6-1 through Fig. 6-3). The boring logs consist of subsurface material layers, type, color, and moisture descriptions as well as strength parameters and soil characteristics determined from the laboratory tests. This site is predominantly a sandy gravel and gravelly sand site with about 25% to 50% fines. The fines are generally plastic (i.e., clayey), and the behavior of the soil in some zones can be cohesive,

PROJECT: PACIFICORP RESEARCH	DRILLING FIRM / OPERATOR: BOART LONGYEAR	DRILL RIG: MINI SONIC RIG	STATION / OFFSET:	EXPLORATION ID TRMTN #1
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: U OF U / ZMC	HAMMER:	ALIGNMENT: TREMONTON 1/52	
PID: 99999 BR ID: N/A	DRILLING METHOD: SONIC DRILLING	CALIBRATION DATE: N/A	ELEVATION: 4377.7 (MSL) EOB: 65.0 ft.	PAGE 1 OF 3
START: 7/19/10 END: 7/19/10	SAMPLING METHOD: BULK	ENERGY RATIO (%):	COORD: 41.728792704, -112.196207464	

MATERIAL DESCRIPTION AND NOTES	Desc	ELEV. 4377.7	DEPTH (ft)	RUN ID	SPT	Zero Drive	SPTT (ft-lbs)	Rec. (in)	Lab ID	Unit Wt. (pcf)	(Su/phi) (psi/deg)	w (%)	GRADATION (%) GR	CS	FS	F	ATTERBERG LL	PL	PI	USCS
WELL GRADED SAND, SILTS AND GRAVELS, FINES WITH LITTLE TO NO PLASTICITY			1, 2	BS-1		--			1	91.9	N/A / 41	21.9	73	10	4	12	38	22	16	SW/SM
SAND, CLAY AND GRAVELS, PLASTIC FINES		4375.2	3, 4	BS-2		--			2	91.9		21.9	65	19	12	4	45	23	22	SW/SC
CLAY, GRAVELS, INORGANIC CLAYS OF HIGH PLASTICITY, HIGH TO VERY STIFF		4372.7	5, 6, 7	BS-3	11 21 37	--	225	18	3	119	5.1 / 69	21.0	9	0	5	86	63	22	41	CH
SAND, CLAY AND GRAVELS, PLASTIC FINES		4370.2	8, 9	BS-4		--			4	135		21.0	30	2	27	41	46	24	22	SC
SAND, CLAY, SILTS, AND GRAVELS, LOW PLASTICITY FINES		4367.7	10, 11, 12	BS-5	22 40 44	--	250	18	5	116		21.2	43	11	8	38	52	29	23	SM/SC
			13, 14	BS-6		--			6	119		25.6	51	29	15	5	47	29	18	SM/SC
			15, 16, 17, TR	BS-7	20 50	/5.5"	250	11.5	7	112	6.0 / 60	20.4	51	15	10	24	42	30	12	SM/SC
			18, 19	BS-8		--			8	117		21.6	55	6	10	29	33	26	7	SM/SC
			20, 21, 22	BS-9	25 48 50	/2"	200	14	9	117		18.3	45	23	11	21	36	26	10	SM/SC
GRAVEL, SILTS, SANDS, AND SOME CLAY, LOW PLASTICITY FINES		4355.2	23, 24	BS-10		--			10	124		20.5	65	8	7	20	37	29	8	GM
SILTY SAND, CLAYS AND GRAVELS, LOW PLASTICITY FINES		4352.7	25, 26, 27	BS-11	30 50	/5"	175	11	11	124		18.2	57	6	15	22	28	24	5	SM
			28, 29	BS-12		--			12	124	12 / 36	25.8	56	8	9	26	41	30	11	SM

Fig. 6-1. Borehole log and soil profile for the Tremonton site from 0 to 30 ft

PID: 99999 | BR ID: N/A | PROJECT: PACIFICORP RESEARCH | STATION / OFFSET: | START: 7/19/10 | END: 7/19/10 | PG 2 OF 3 | TRMTN #1

MATERIAL DESCRIPTION AND NOTES	Desc	ELEV. 4347.7	DEPTH (ft)	RUN ID	SPT	Zero Drive	SPTT (ft-lbs)	Rec. (in)	Lab ID	Unit Wt. (pcf)	(Su/phi) (psi/deg)	w (%)	GRADATION (%) GR	CS	FS	F	ATTERBERG LL	PL	PI	USCS
CLAYEY SAND, SAND-CLAY MIXTURES, GAVELS, PLASTIC FINES		4347.7	31, ▼32	BS-13	31 50	/3"	210	9	13	110		17.8	48	17	11	24	40	24	16	SC
SILTY SAND, SILT-SAND MIXTURES, CLAYS GRAVELS, LOW PLASTICITY FINES		4345.2	33, 34	BS-14		- -			14	110		26.5	39	15	9	38	40	28	11	SM
CLAYEY SAND, SAND-CLAY MIXTURES, GAVELS, PLASTIC FINES		4342.7	35, 36, 37	BS-15	28 50	/3"	220	9	15	128		22.0	53	13	9	24	32	24	8	SC
SANDY CLAY, SILTY SAND, GRAVELS, TRANSITIONAL MATERIALS		4340.2	38, 39	BS-16		- -			16	128		20.2	47	18	8	26	37	24	12	SM/SC
			40, 41, 42	BS-17	50	/1"	180	1	17	128	25 / 42	19.1	43	15	9	33	36	24	12	SM/SC
			43, 44	BS-18		- -			18	128		18.6	40	22	12	27	29	21	8	SM/SC
SILTY SAND, SILT-SAND MIXTURES, CLAYS GRAVELS, LOW PLASTICITY FINES		4332.7	45, 46, 47	BS-19	50	/4"	180	4	19	128		23.2	39	18	12	31	35	26	9	SM
SANDY CLAY, SILTY SAND, GRAVELS, TRANSITIONAL MATERIALS		4330.2	48, 49	BS-20		- -			20	128		17.6	47	17	11	24	31	21	10	SC
			50, 51, 52	BS-21	50	/4"	130	4	21	111		20.9	48	11	11	30	32	23	9	SM/SC
			53, 54	BS-22		- -			22	111		9.5	46	16	10	27	30	18	12	SC
CLAY, GRAVELS, INORGANIC CLAYS OF HIGH PLASTICITY, HIGH TO VERY STIFF		4322.7	55, 56, 57	BS-23	50	/5"	75	5	23	124	16 / 28	24.4	33	5	9	52	63	26	37	MH
			58, 59	BS-24		- -			24	124		38.5	6	23	19	52	64	30	34	MH
CLAYEY SAND, SAND-CLAY MIXTURES, GAVELS, PLASTIC FINES		4317.7	60, 61	BS-25	50	/5"	240	5	25	118		16.7	43	22	11	24	33	20	13	SC

Fig. 6-2. Borehole log and soil profile for the Tremonton site from 30 to 62 ft

PID: 99999	BR ID: N/A	PROJECT: PACIFICORP RESEARCH	STATION / OFFSET:	START: 7/19/10	END: 7/19/10	PG 3 OF 3	TRMTN #1

MATERIAL DESCRIPTION AND NOTES	Desc	ELEV. 4315.5	DEPTH (ft)	RUN ID	SPT	Zero Drive	SPTT (ft-lbs)	Rec. (in)	Lab ID	Unit Wt. (pcf)	(Su/phi) (psi/deg)	w (%)	GRADATION (%) GR	CS	FS	F	ATTERBERG LL	PL	PI	USCS
			63 64	BS-26		--			26	127		22.0	56	6	10	28	33	23	10	SC
		4312.7	65	BS-27	21 33 45	--	90	18												

Fig. 6-3. Borehole log and soil profile for the Tremonton site from 62 to 65 ft

especially within the zone from 5 to 10 ft. Because of the high gravel content of this soil, the recorded N_{SPT} are suspected (i.e., probably too high) because of plugging and blocking of the opening of the sampler by oversized particles as it was driven. Therefore, the penetration values shown in Fig. 6-1 through Fig. 6-3 are most likely not a suitable representation of the engineering behavior of the soil, and therefore, not used in the design.

6.3 Index Properties versus Depth

As previously discussed in Chapter 5, the index tests conducted during the laboratory investigation include unit weight, water content determination, Atterberg tests, and particle size analyses. The results of each of these tests are presented in a plot versus depth profile (Fig. 6-4 through Fig. 6-9).

6.4 *P-y* Curves Developed from PMT Data

As discussed in Section 2.4, the development *P-y* curves (i.e., lateral load versus deflection curves) to analyze the behavior of laterally loaded piles is used widely in geotechnical practice. The software program utilized in this study, *LPILE*, uses *P-y* curves to analyze the performance of the deep foundation. One of the ways the *P-y* curves can be developed is using pressuremeter (PMT) results that are entered by the design engineer. The data obtained from a pressuremeter test makes it possible to construct a *P-y* curve. This curve can represent the resistance of the soil reasonably well when the pressuremeter tests and data reduction are properly performed. The *P-y* curves are developed for large diameter shafts by extrapolating the pressures and displacement

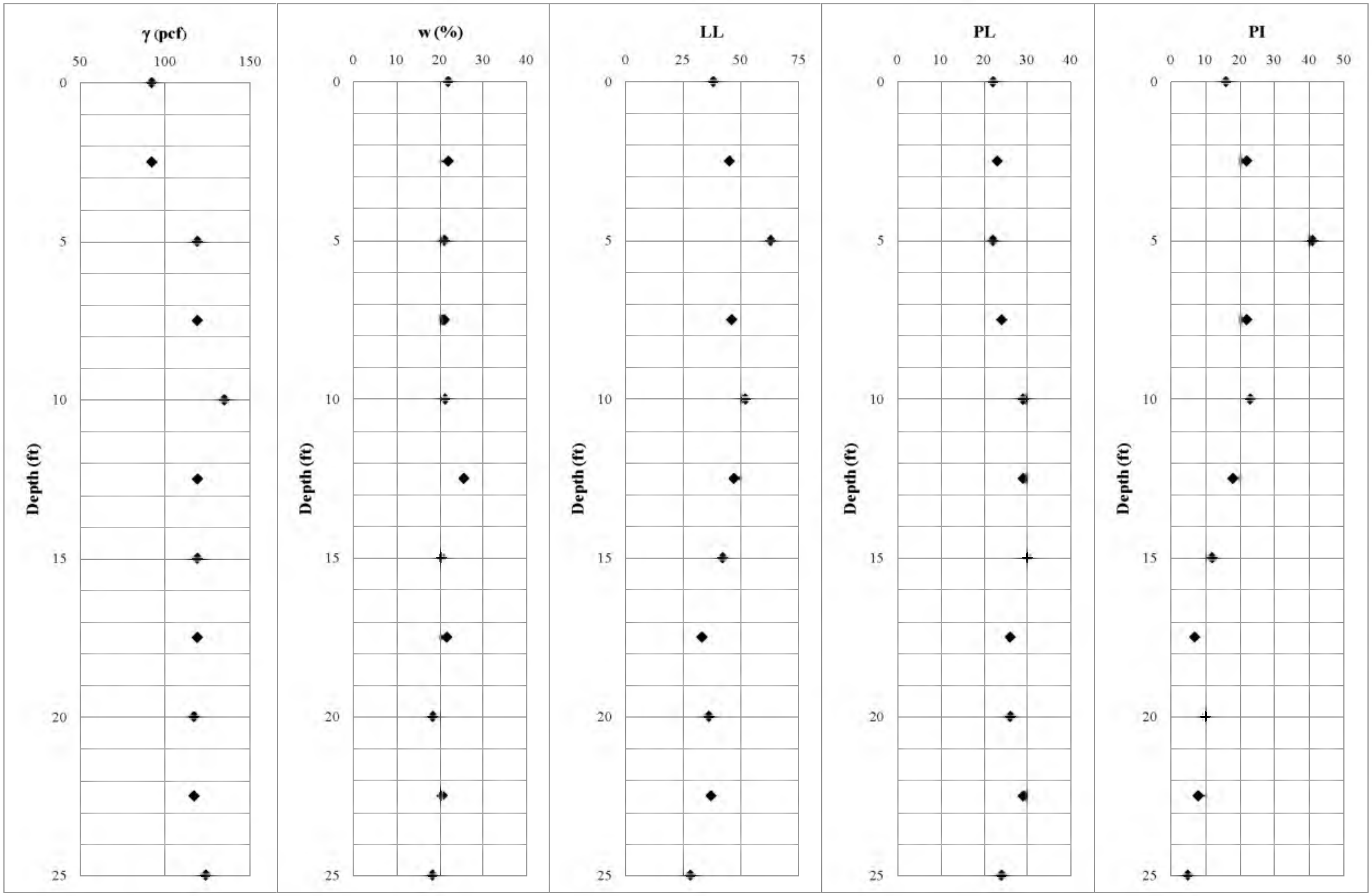

Fig. 6-4. Soil unit weight, moisture content, liquid limit, plastic limit, and plasticity index versus depth for the Tremonton site from 0 to 25 ft

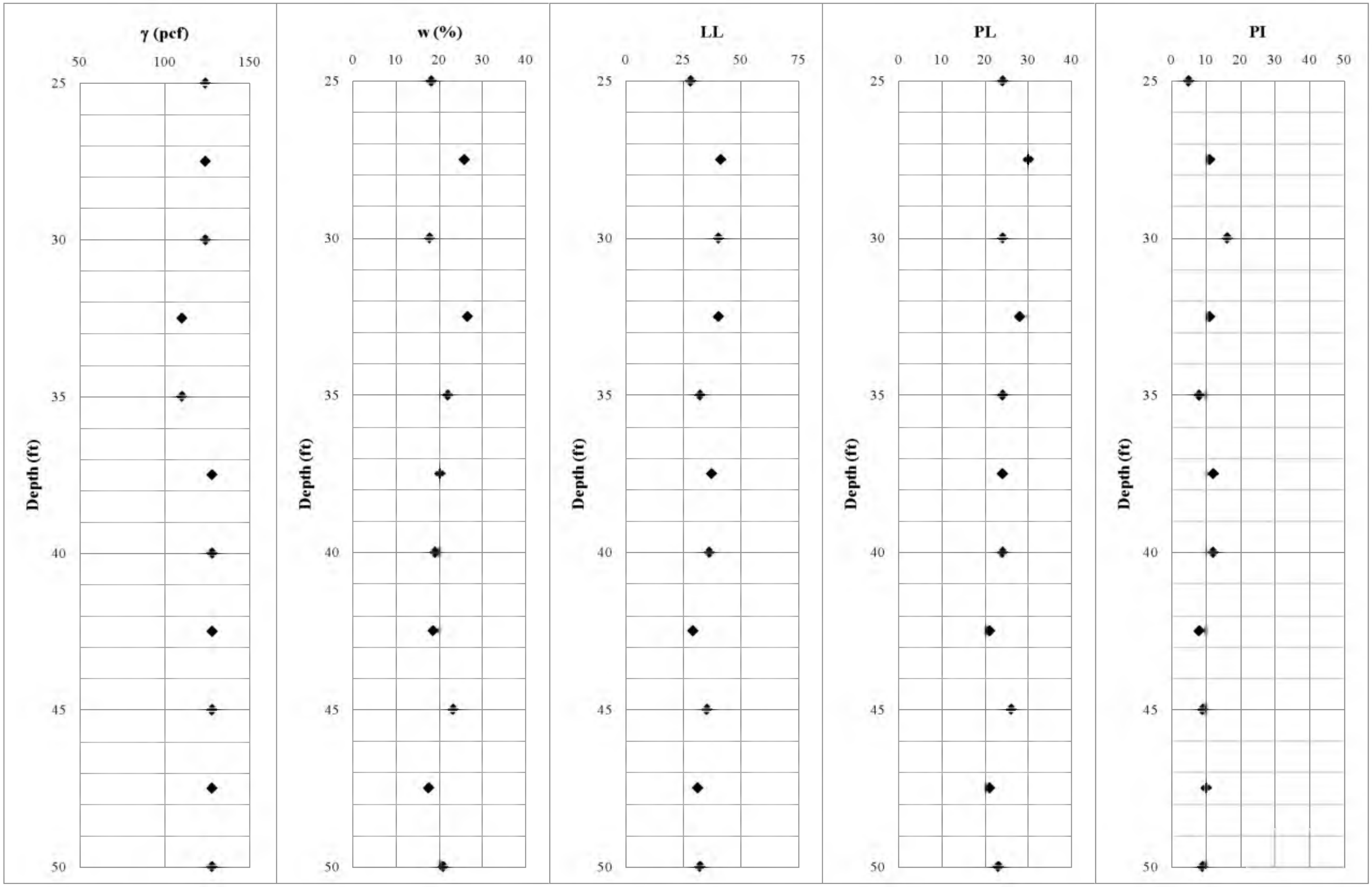

Fig. 6-5. Soil unit weight, moisture content, liquid limit, plastic limit, and plasticity index versus depth for the Tremonton site from 25 to 50 ft

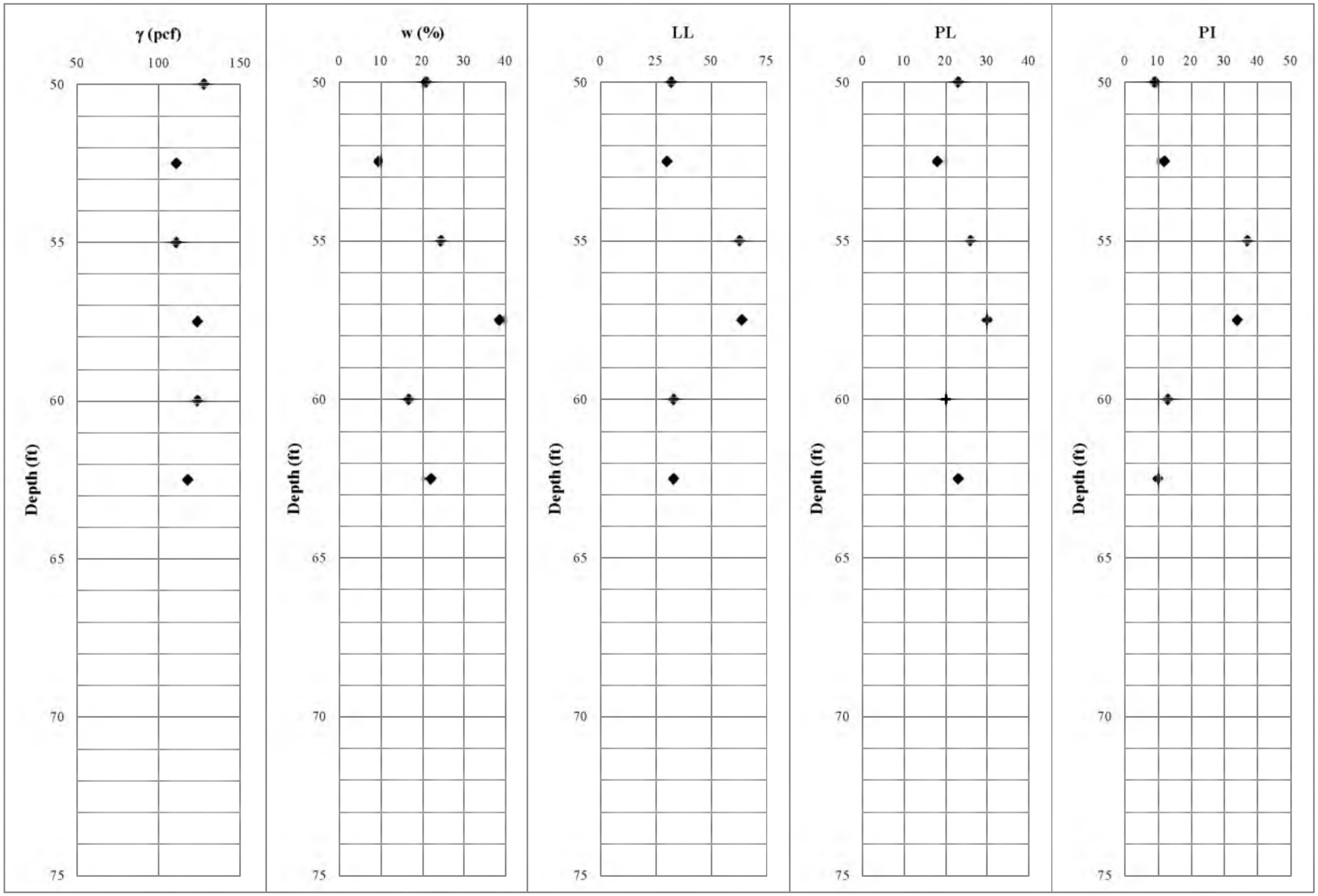

Fig. 6-6. Soil unit weight, moisture content, liquid limit, plastic limit, and plasticity index versus depth for the Tremonton site from 50 to 65 ft

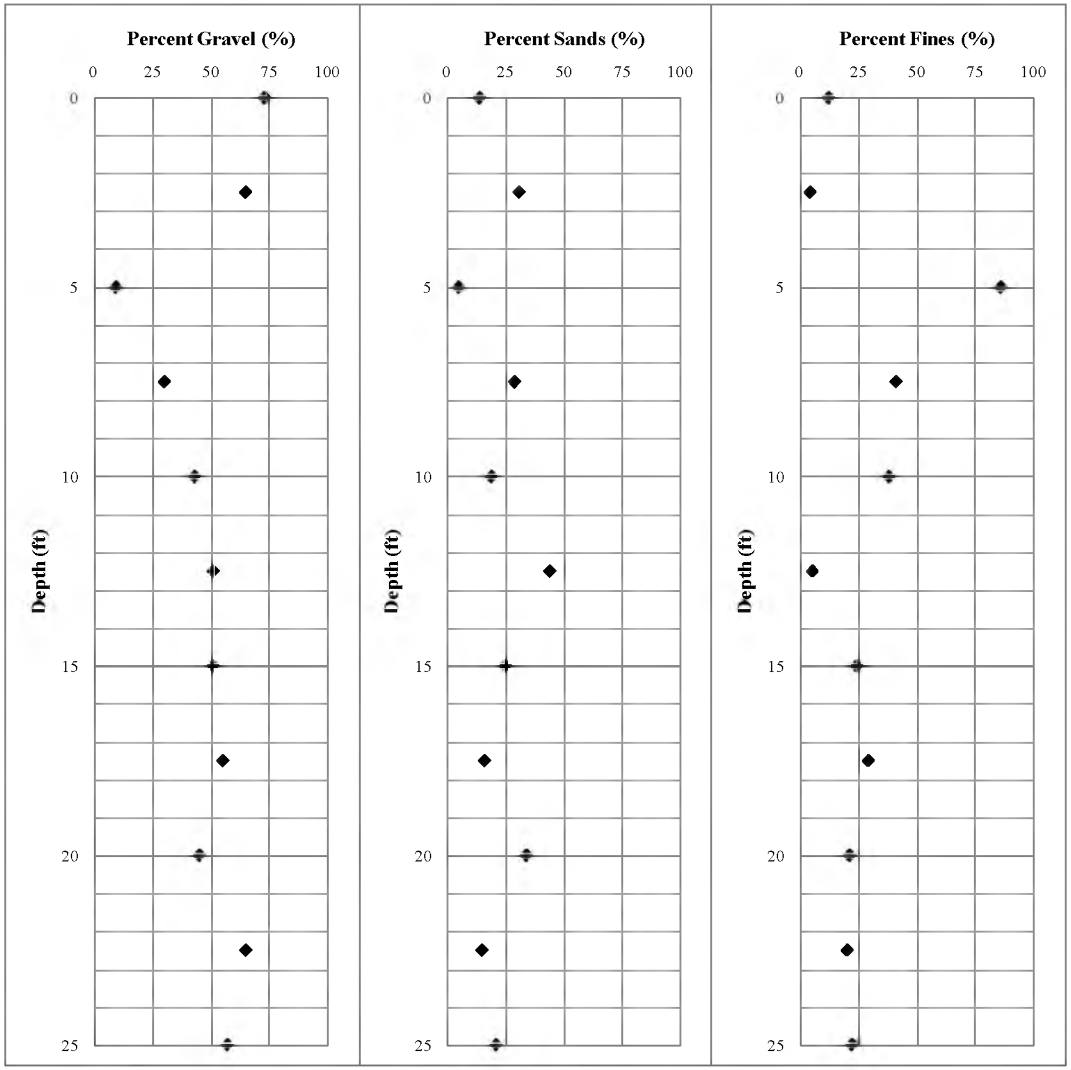

Fig. 6-7. Gravel, sands, and fines content versus depth for the Tremonton site from 0 to 25 ft

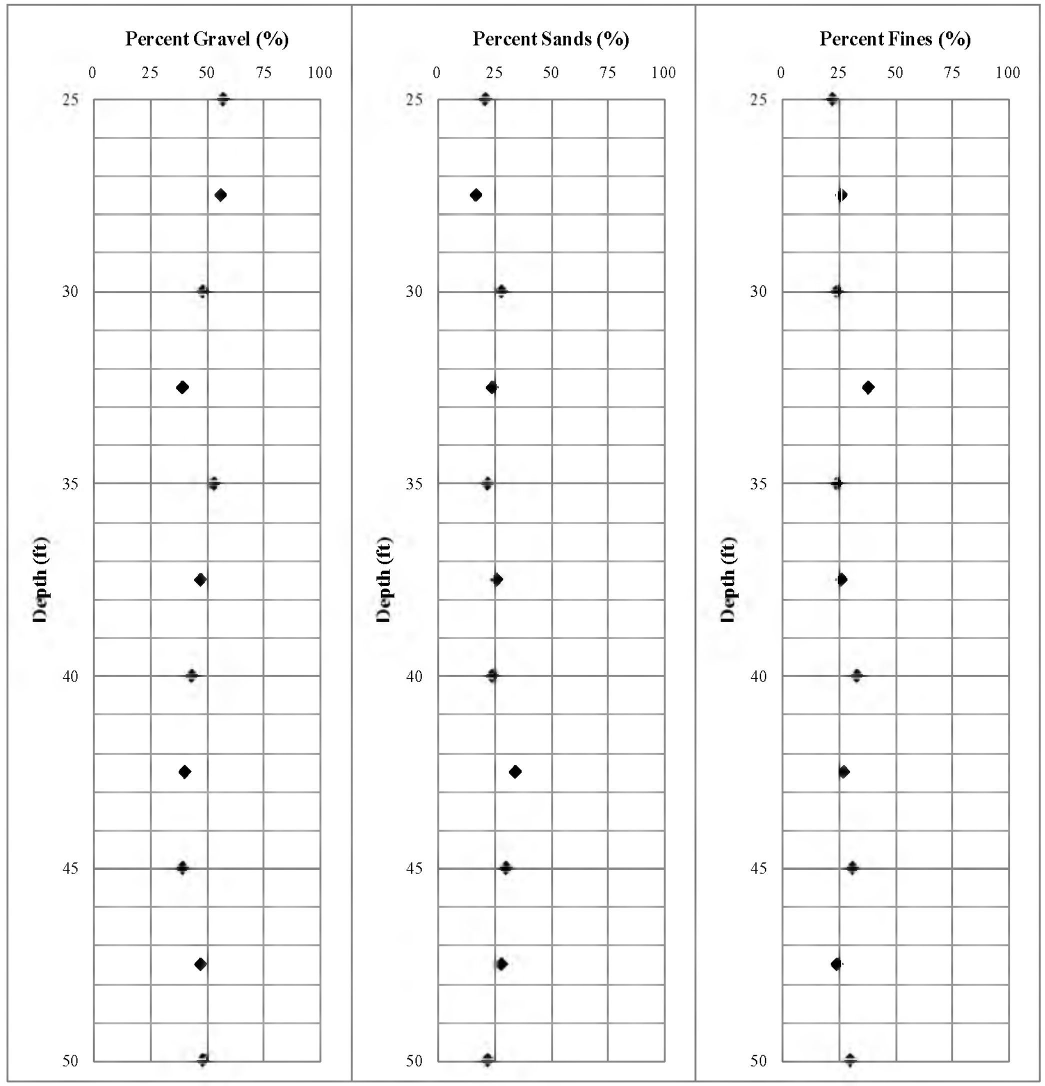

Fig. 6-8. Gravel, sands, and fines content versus depth for the Tremonton site from 25 to 50 ft

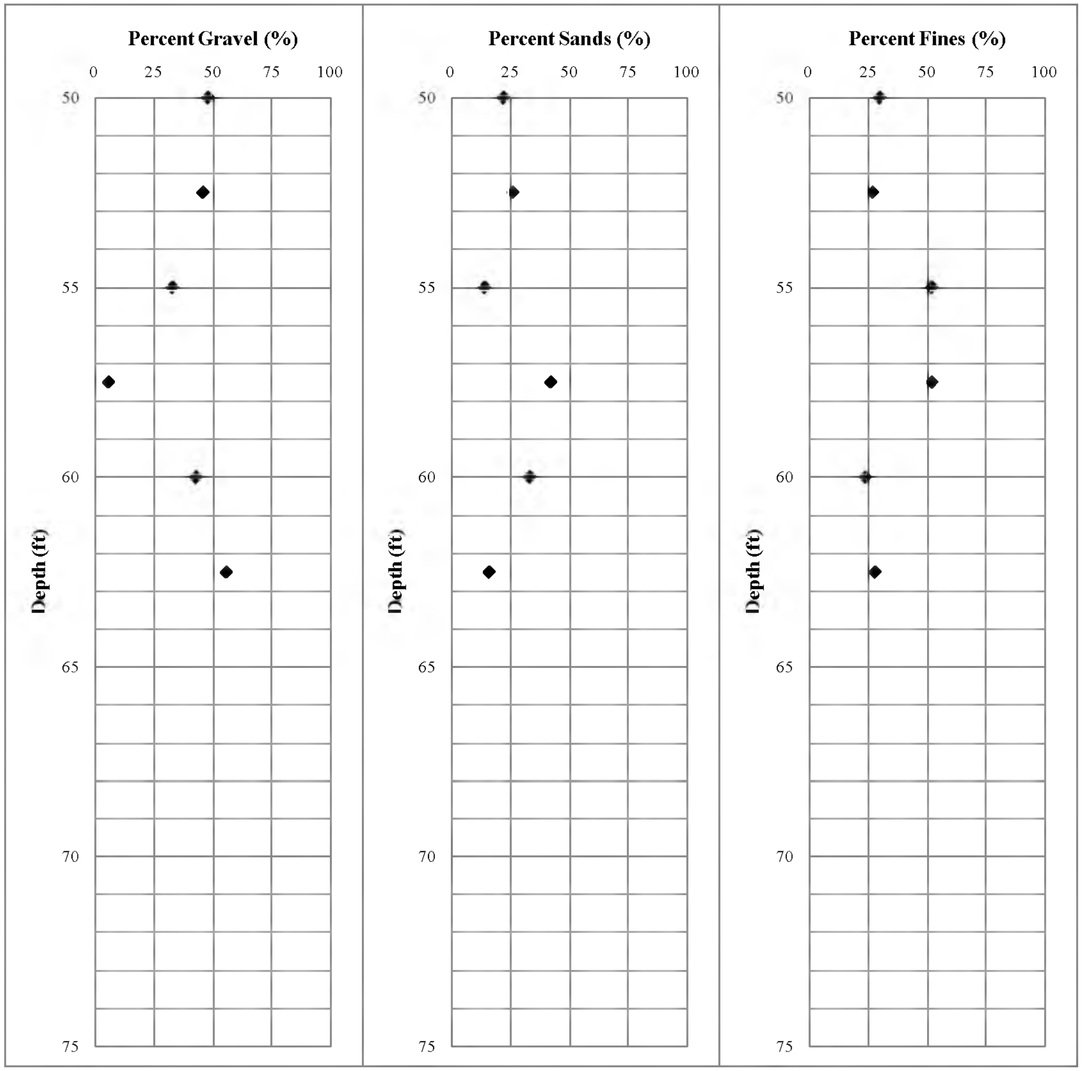

Fig. 6-9. Gravel, sand, and fines content versus depth for the Tremonton site from 50 to 65 ft

experienced by the pressuermeter probe during a test. Because the pressuremeter data gives values of pressure versus probe expansion, it can be correlated to pressure versus deflection of the soil. *P-y* (load versus deflection) curves can then be developed point by point from the pressuremeter data. The transformation process for one pressuremeter curve measured at an approximate depth of 14.5 ft at the Tremonton site is detailed below. The process was performed using Briaud (1992) and Smith (1987) as the primary references.

The first step to transform the data was to correct the pressuremeter data for the membrane and volume loss calibrations that were performed on site. The membrane correction accounts for the radial pressure needed to overcome the resistance of the membrane in air. This value was subtracted from each value of pressure recorded. A second correction is needed to account for the volume loss that occurs due to the expansion of the system, including the tubing, fittings, etc. Also, the hydrostatic pressure in the hydraulic lines at the test depth must be added to the pressure reading as a result of the difference in elevation between the pressure transducer location (just above the ground surface) and the elevation at which the test was performed (below the ground surface).

The calibration data for membrane resistance was obtained by expanding the pressuremeter probe to high levels of pressure under atmospheric pressure conditions, with the results shown in Fig. 6-10. A polynomial best-fit trend line was applied to the data series, and an expression of pressure versus volume expansion was obtained. The calibration for the volume loss was performed by inserting the probe into a very stiff steel sleeve with a diameter slightly larger than the probe to ensure a tight fit. Hydraulic fluid

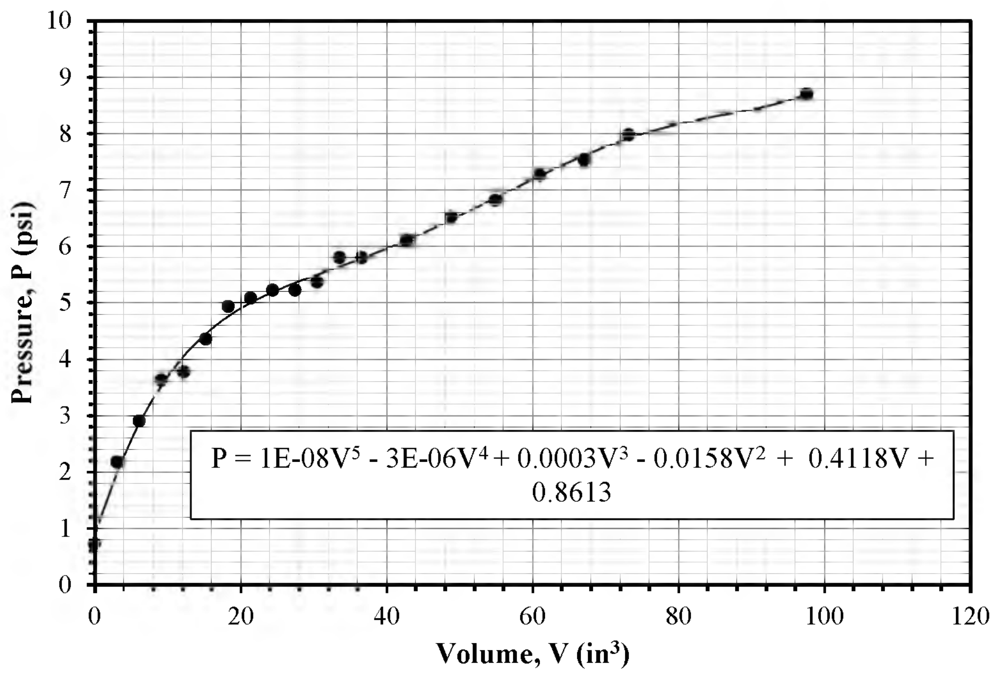

Fig. 6-10. PMT membrane calibration curve

was then pumped into the system and values of pressure and volume expansion were recorded. The data from the calibration test is presented in Fig. 6-11.

The expression for this correction was obtained by drawing a line tangent to the linear portion of the data series as shown in Fig. 6-11. The tangent line was extended to the volume axis and the intersection marked the location as the transformed axis from which the volume correction would be referenced. The correction that was subtracted from the raw volume data points was taken as the difference between the tangent line and the transformed vertical axis.

The correction for the hydrostatic pressure consisted of adding the hydrostatic pressure due to the column of hydrostatic fluid that exists in the hydraulic lines between the control unit of the pressuremeter tests and the testing depth in the borehole to the raw pressure reading. The hydrostatic pressure was determined by multiplying the unit

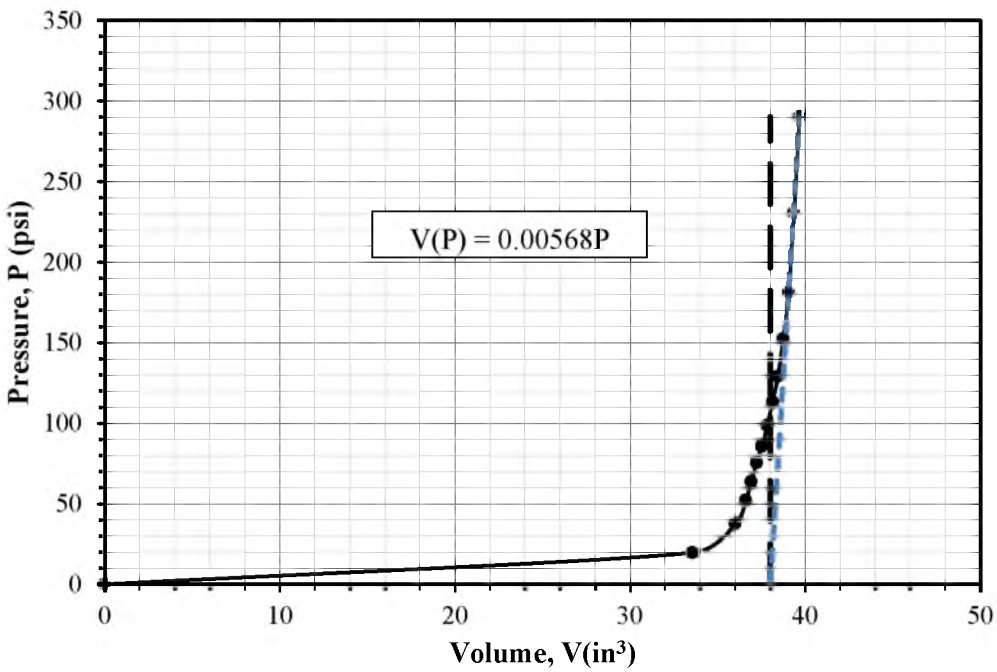

Fig. 6-11. PMT volume loss calibration curve

weight of the hydraulic fluid by the depth to the center of the probe during any particular test. The specific gravity of the hydraulic fluid was taken to be 1.03. Pressuremeter curves are shown for both the corrected and raw data from the test completed at 14.5 ft (Fig. 6-12).

The next step in developing the *P-y* curve was to create an axis shift to a reference origin that represents the pressure and radial expansion of the membrane when it contacted the wall of the borehole. Following the methods detailed in Briaud (1992), this was done by determining the in-situ horizontal stress, which is taken as the point of maximum curvature on the pressuremeter curve, represented by Fig. 6-13. However, some of the other curves created from the tests performed at the Tremonton site had very gradual curves caused by gravel seating and borehole disturbance from drilling in the cobbles and gravels located within the soil profile. Thus, estimates of the coefficient of

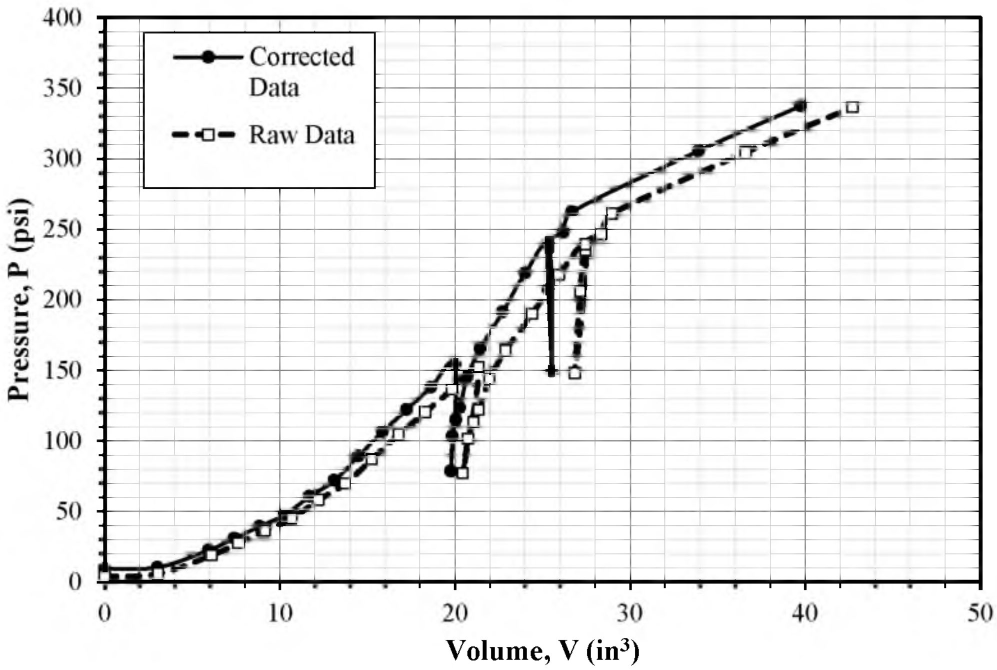

Fig. 6-12. Raw and corrected pressuremeter curves for the test performed at 14.5 ft

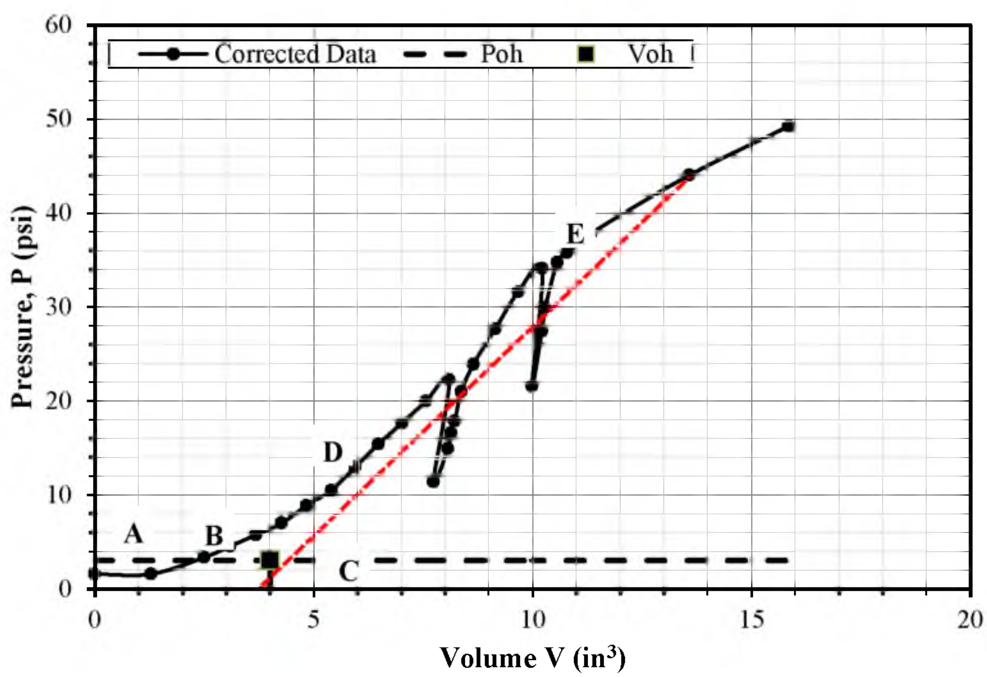

Fig. 6-13. Corrected pressuremeter curve showing the axis shift procedure for a depth of 14.5 ft

earth pressure at rest K_o, were used to help establish the in-situ horizontal stress σ_{oh}.

A line through points D-E was then used to represent the modulus of the pressuremeter curve. Line D-E was extended until it intersected the horizontal line A-B. This intersection, represented as point C in Fig. 6-13 was taken as the origin for the axis shift, representing the point at which the in-situ horizontal stress was reached as the membrane contacted the wall of the borehole. The pressuremeter curve with axis shift applied for the test performed at a depth of 14.5 ft for the Tremonton site is presented in Fig. 6-14.

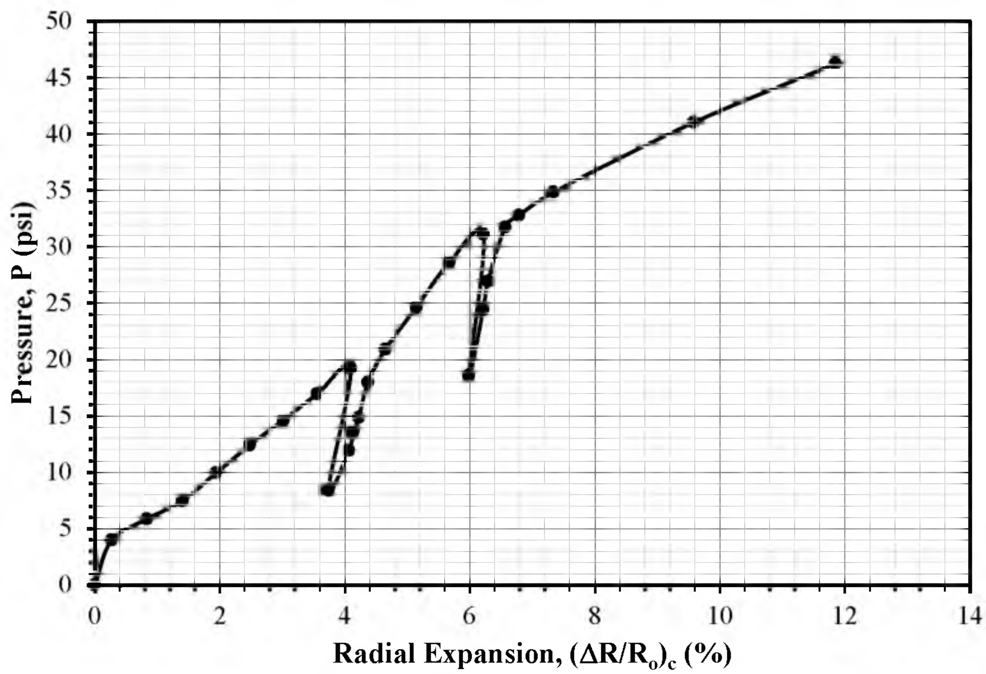

Fig. 6-14. Pressuremeter curve after axis shift for a depth of 14.5 ft

The next step in developing the P-y curve was to sum the two load versus displacement curves, Q-y and F-y, representing the normal resistance and shear resistance, respectively. The Q-y curve was constructed point by point from the data values in the transformed loading curves (e.g., Fig. 6-14), utilizing equations Eq. 6-1 through Eq. 6-3.

$$Q = p^{*} D_S SF \qquad \text{Eq. 6-1}$$

$$y = \frac{\Delta R_c}{R_c} D_S \qquad \text{Eq. 6-2}$$

$$\frac{\Delta R_c}{R_c} = \sqrt{\frac{V_o + v_c}{V_c}} \qquad \text{Eq. 6-3}$$

where: Q represents the normal resistance, p^{*} is the net increase in pressure, D_S is the shaft diameter, SF is a safety factor taken as ($\pi/4$) for circular shafts, y is the displacement of the shaft, $(\Delta R_c/R_c)$ is the radial expansion of the soil cavity, V_o is the initial volume of the probe, v_c is the corrected volume reading, and V_c is the volume of the membrane upon reaching contact with the soil cavity wall.

The P-y curves were all developed using a shaft diameter of 11 ft, which is the minimum allowable shaft diameter as governed by the geometrical dimensions of the transmission line tower. The first step to develop the shear force versus displacement curve (F-y) was to compute the shearing strength of the soil along the soil-shaft interface. In this case, a reasonable estimate was obtained from equations developed for the axial skin resistance of a vertically loaded drilled shaft (q_{sL}). Since there are many methods to analyze the shaft resistance, a best estimate regression was determined from plotting a few selected methods based on the data that was obtained from the field and laboratory testing. Eq. 6-4 is an equation for the drained shaft resistance in sands by Flemming (1992) as reported in Salgado (2008). Eq. 6-5 is a general equation for the shaft resistance in clays. Eq. 6-6 is from Salgado (2008) and is one of several equations available in literature for the coefficient α.

$$q_{sL,(sands)} = K\sigma'_v \tan(\delta) \qquad \text{Eq. 6-4}$$

$$q_{sL,(clays)} = \alpha s_u \qquad \text{Eq. 6-5}$$

$$\alpha = 0.4\left[1 - 0.12\ln\left(\frac{s_u}{p_A}\right)\right] \qquad \text{Eq. 6-6}$$

where: K is the coefficient of lateral earth pressure taken as 0.7, δ is the critical state friction angle ϕ'_c, σ'_v is the effective vertical stress, s_u is the undrained shear strength of the soil, and p_A is the reference stress (atmospheric pressure). This equation for α provides a conservative value for soils with an overconsolidation ratio (OCR), < 3.0 (Salgado, 2008). Becuase no reliable data were available for OCR from the geotechnical investigation, a value of 2.0 was chosen based on extensive experience with Lake Bonneville sediments by Dr. Evert Lawton and Dr. Steven Bartlett. In addition, α was also estimated using Eq. 6-7 from Chen and Kulhawy (2003), for comparison purposes.

$$\alpha_{CIUC} = 0.52 - 0.51\log\left(\frac{s_{u_{CIUC}}}{p_A}\right) \qquad \text{Eq. 6-7}$$

The results from the PMT and the SPT-T were also used to estimate q_{sL} using Eq. 6-8 as described in Lutenegger and Kelley (1998):

$$q_{sL} = \frac{2T}{\pi d^2 L} \qquad \text{Eq. 6-8}$$

where: T is the measured value of torque from the torque wrench during the SPT-T, d is the diameter of the spoon sampler used, and L is the length of penetration of the spoon sampler into the soil.

All four methods were then plotted and used to determine a best estimate by visual inspection. The values found by using the strength parameters from the triaxial testing were taken as the lower bound, due to the fact that the samples that were tested had to be reconstituted, which destroyed all the natural cementation that had occurred over thousands of years. The values obtained from the SPT-T were taken as the upper bound due to the not always consistent penetration of the sampler into the soil. It was explained in Lutenegger and Kelly (1998), that based on correlation from Meyerhof (1976), that the values of q_{sL} determined from the SPT-T results are normally twice that of Meyerhof's trend, which essentially represents a lower bound value of q_{sL} for bored piles (drilled shafts). The data obtained from all four different methods of determining the shaft resistance as well as the best estimate regression line were used to determine the final values used in the F-y curve construction and are presented in Fig. 6-15.

Once the shaft resistance was found for each individual depth of testing, equations Eq. 6-9 through Eq. 6-11, from Smith (1987) and Briaud (1992) were used to develop the final F-y curve.

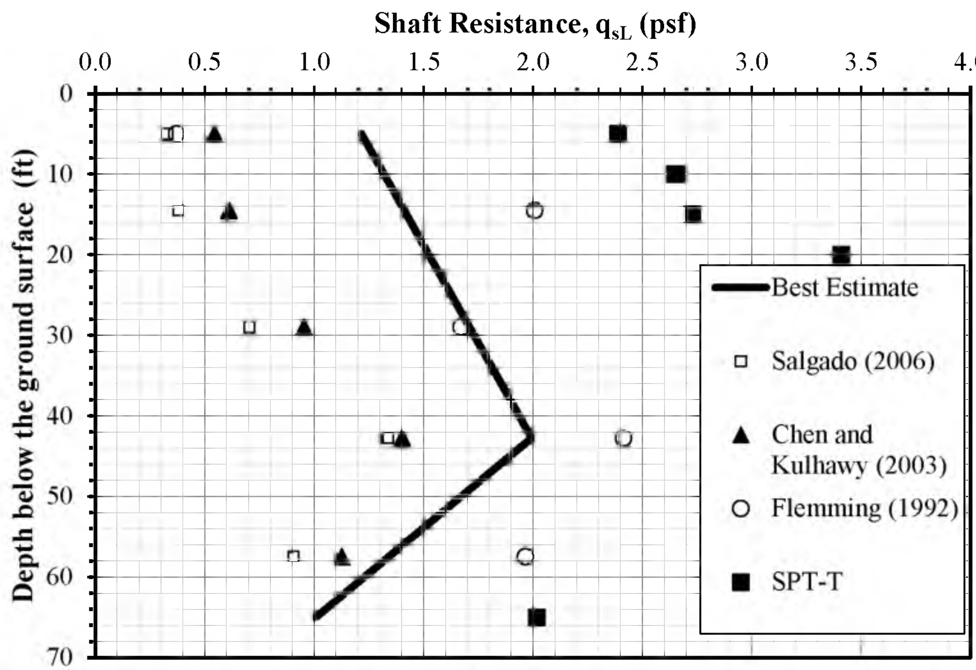

Fig. 6-15. Comparison plot of the methods used to determine the shaft resistance

$$F = f_s D_S SF \qquad \text{Eq. 6-9}$$

$$y = \frac{\Delta R_c}{R_c} D_S \qquad \text{Eq. 6-10}$$

$$\frac{F_u}{y_{\max}} = \frac{E_R}{1.33} \qquad \text{Eq. 6-11}$$

The *P-y* curve is expressed as the sum of the *Q-y* curve and *F-y* curve. The *P-y* curve is shown in addition to the seperate *Q-y* curve and the *F-y* curve for the test performed at a depth of 14.5 ft below existing ground surface elevation in Fig. 6-16.

The effect that the *F-y* resistance had was only a small portion of the total *P-y* resistance, therefore the approximations used to determine *F-y* have negligible effect on the final *P-y* results. The final *P-y* curve is shown in Fig. 6-17 and was produced by

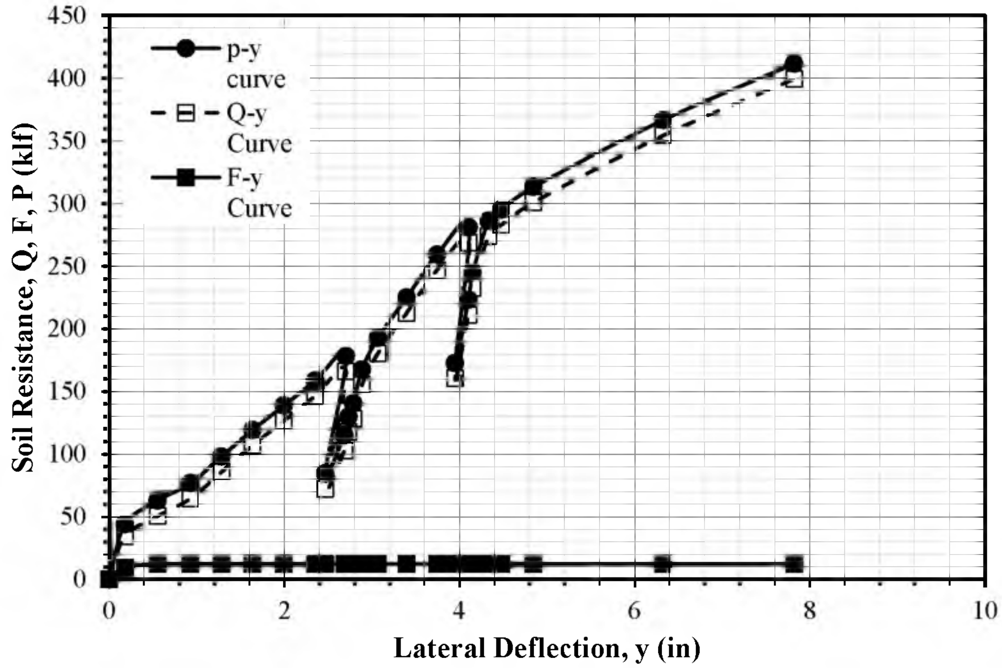

Fig. 6-16. *Q-y*, *F-y*, and *P-y* curves for a depth of 14.5 ft

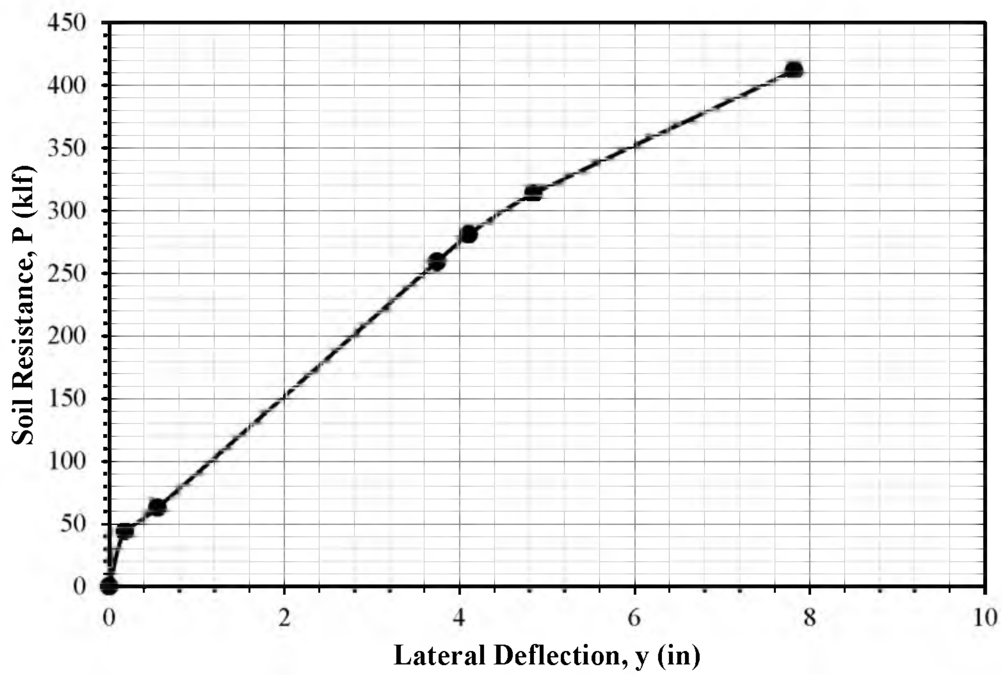

Fig. 6-17. Final *P-y* curve for the testing depth of 14.5 ft

selecting appropriate data points from the full *P-y* curve that would encompass the representative linear portions of the curve.

To account for the fact that the pressuremeter tests were not performed at the center of each soil layer and that soil stiffness increases with depth in each individual layer, the mean effective stress was determined using Eq. 6-12.

$$\sigma'_m = \frac{\sigma'_v(1 + 2K_o)}{3} \qquad \text{Eq. 6-12}$$

A plot of the mean effective stress (σ'_m) versus depth was constructed (Fig. 6-18) and it was assumed that the *P-y* resistance was linearly related to σ'_m within each layer. The relationship between the mean normal effective stress σ'_m, and the depth below existing ground surface elevation was then used to determine the *P-y* curves at the top and bottom of each layer, with linear interpolation specified within *LPILE*.

The process described above for constructing the *P-y* curves from the PMT results was repeated for all PMT test depths of 5.0 ft, 14.5 ft, 29.0 ft, 42.8 ft, and 57.5 ft. The final *P-y* curves for each of the PMT depths are presented in Fig. 6-19 through Fig. 6-23, respectively. A comparison of all the *P-y* curves determined from the PMT is presented in Fig. 6-24. In addition, the *P-y* curves are expressed in point by point coordinates for each of the testing depths in Table 6-1. The provided results in Table 6-1 are used as inputs for *LPILE* as described in subsequent chapters.

6.5 Triaxial Testing Data

To achieve soil properties that would be expected to be seen in the same stress path as the laterally loaded shafts, the shear strength parameters found from the triaxial

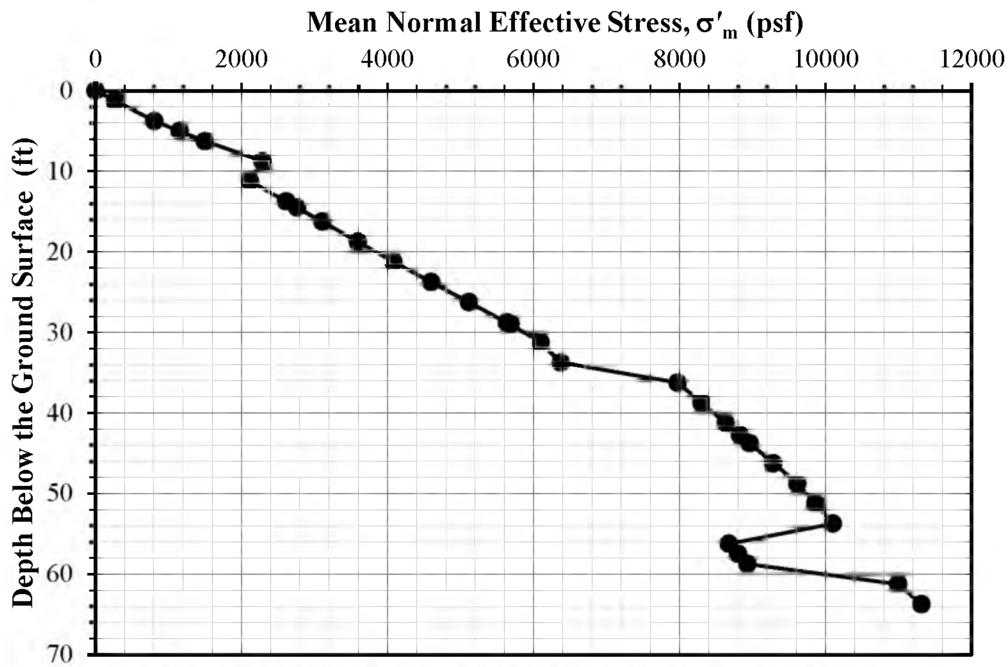

Fig. 6-18. Mean normal effective stress versus depth

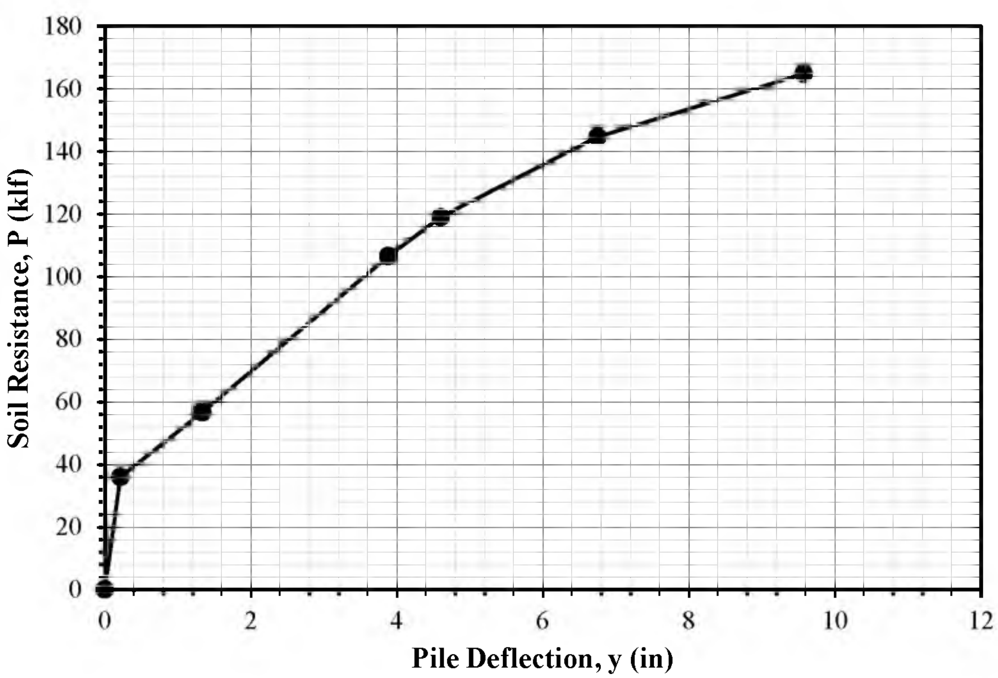

Fig. 6-19. Final *P-y* curve for the testing depth of 5.0 ft

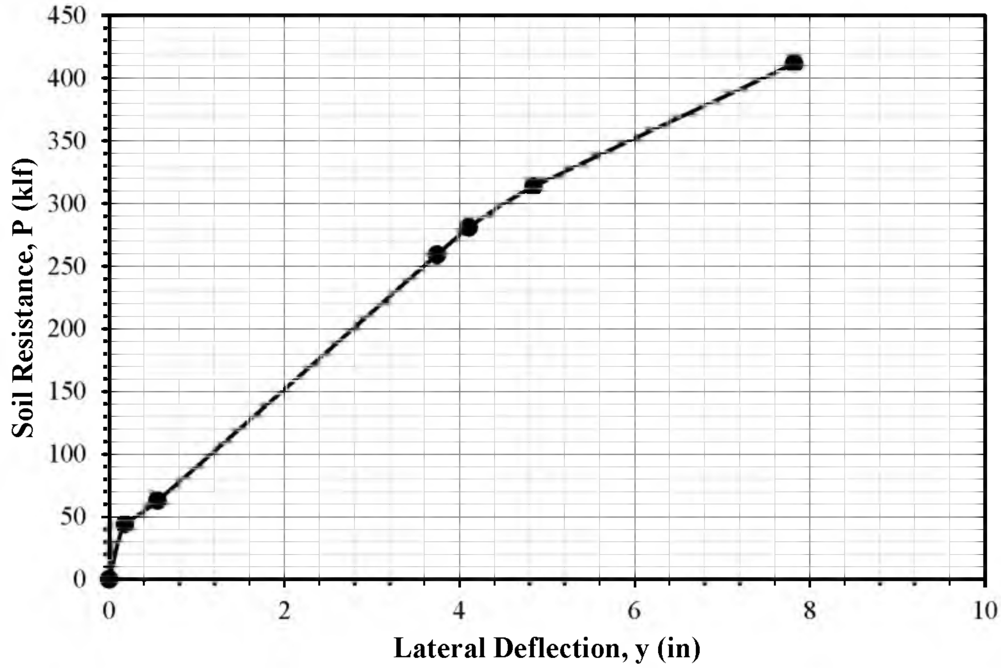

Fig. 6-20. Final *P-y* curve for the testing depth of 14.5 ft

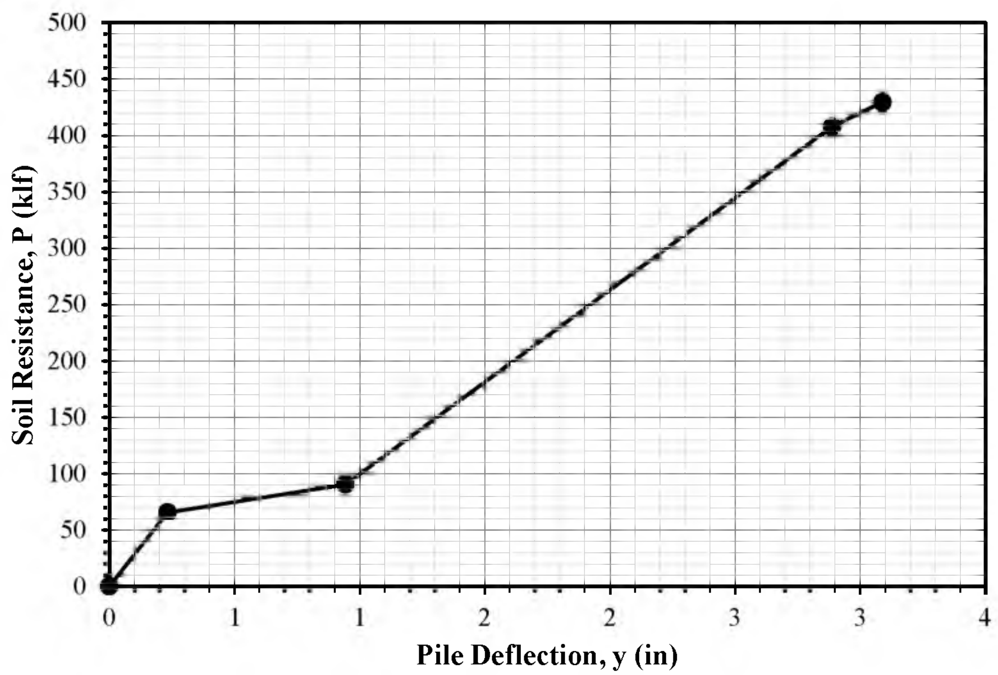

Fig. 6-21. Final *P-y* curve for the testing depth of 29.0 ft

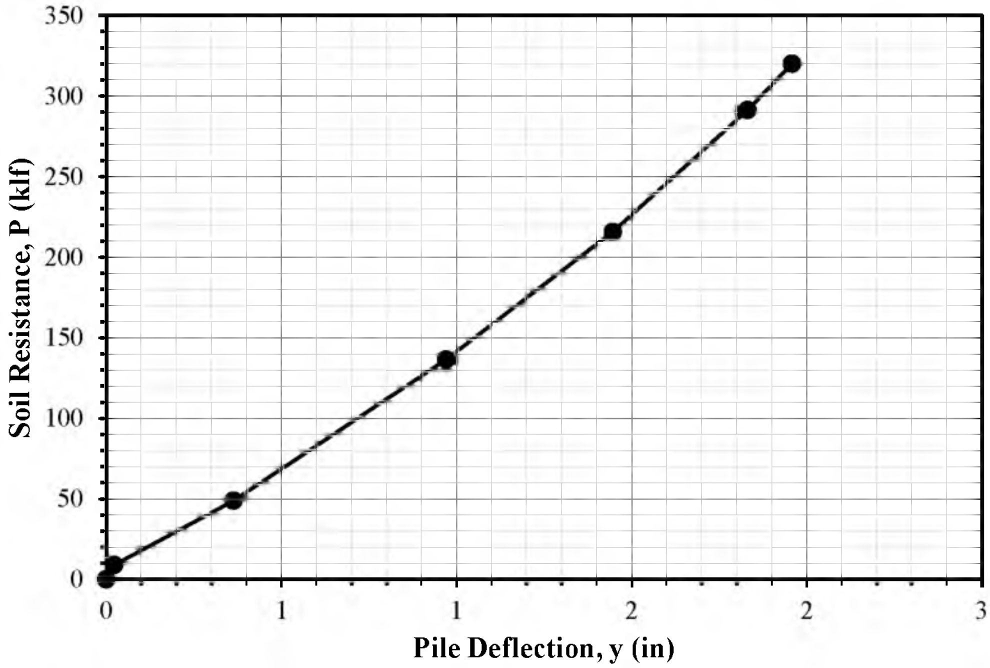

Fig. 6-22. Final *P-y* curve for the testing depth of 42.8 ft

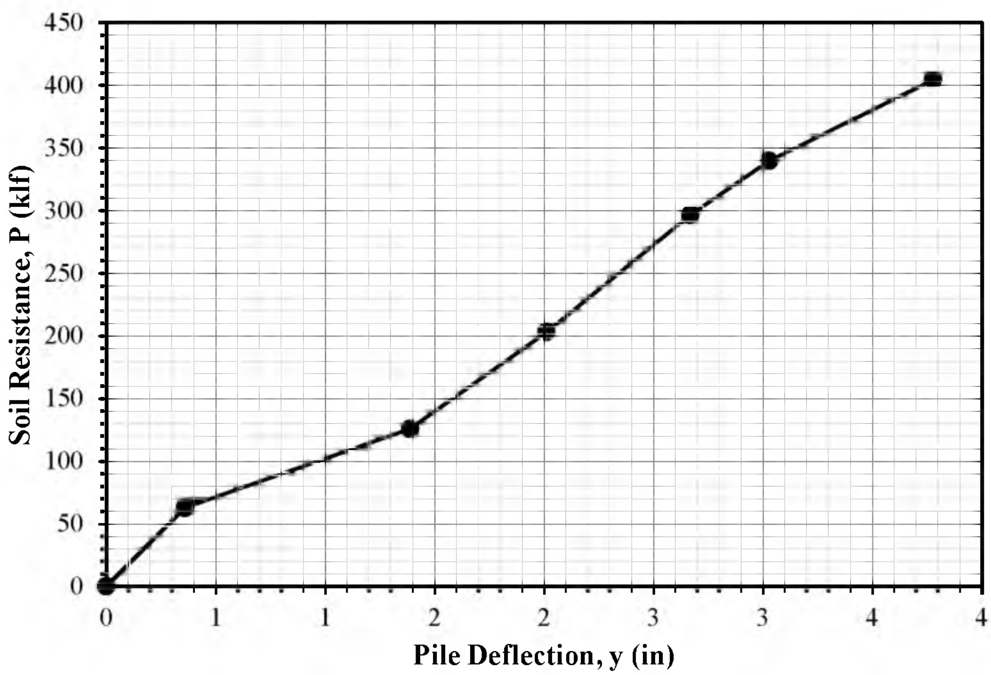

Fig. 6-23. Final *P-y* curve for the testing depth of 57.5 ft

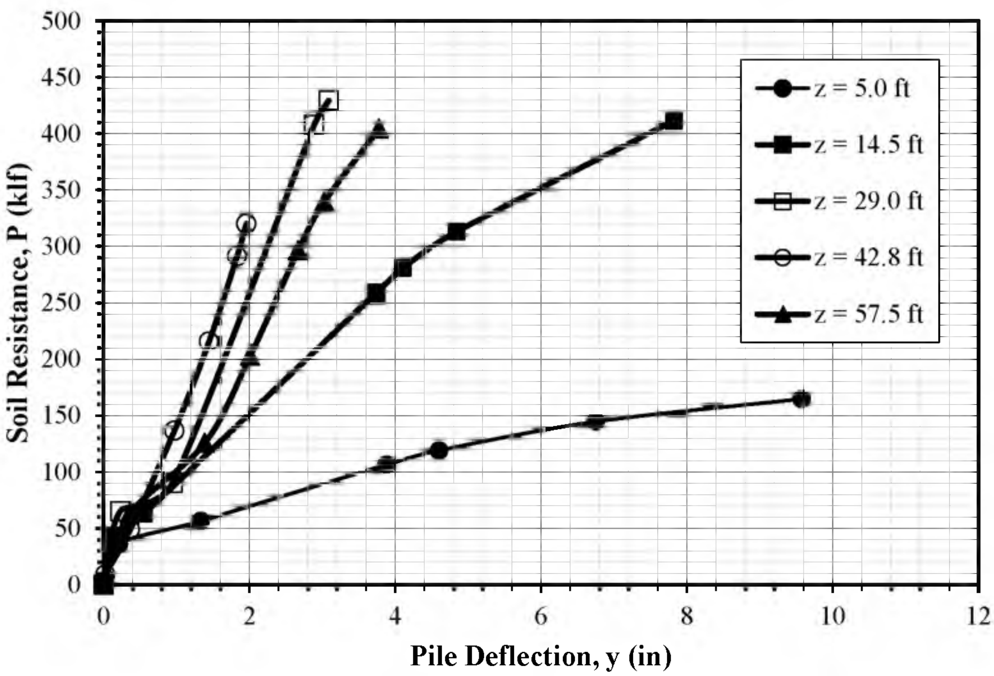

Fig. 6-24. *P-y* curves determined for all depths from the Tremonton site

Table 6-1. Summary of *P-y* Curves for all PMT Testing Depths

Test 12 (5.0 ft)		Test 13 (14.5 ft)		Test 14 (29 ft)		Test 15 (42.5 ft)		Test 17 (57.5 ft)	
p (lb/in.)	y (in)	p (lb/in.)	y (in)	p (lb/in.)	y (in)	p (lb/in.)	y (in)	p (lb/in.)	y (in)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3000	1.25	3650	1.57	5460	0.23	745	0.34	5220	0.33
4720	4.97	5230	3.60	7530	0.94	4070	0.64	10500	2.45
8880	5.64	21600	3.95	34000	2.89	11400	0.92	16900	2.57
9920	6.31	23400	4.66	35800	3.09	18000	1.37	24700	2.78
12100	7.63	26100	6.08			24300	1.74	28300	3.47
13700	8.95	34300	7.52			26700	1.86		

compression tests were converted into triaxial extension shear strength parameters. This was completed using Eq. 6-13 and Eq. 6-14 as presented in Kulhawy and Mayne (1990).

$$\phi'_{te} = 1.12\phi'_{tc} \qquad \text{Eq. 6-13}$$

$$\left(\frac{s_u}{\sigma'_v}\right)_{(CK_oUE)} = \left(0.56 - 0.0046\phi'_{CIUC}\right)\left(1 + 0.1\log\varepsilon'\right)\left(OCR^{0.82}\right)\left(\frac{s_u}{\sigma'_v}\right)_{CIUC} \qquad \text{Eq. 6-14}$$

where: ϕ'_{te} is the triaxial extension based friction angle, ε' is the strain rate of the triaxial test performed in (%/hr), and OCR is the overconsolidation ratio of the soil. For all s_u based correlations performed, OCR was taken to be a constant value of 2.0. The soil profile at the Tremonton site was determined to be overconsolidated due to secondary compression and evidence of cementation from calcium carbonate build up within the soil layers. The comparison between the triaxial compression data found from performing the test and the triaxial extension data values that were determined for the small and large diameter tests are shown in Table 6-2 and Table 6-3, respectively.

Table 6-2. Triaxial Compression and Triaxial Extension Strength Parameters from 2.8 in. Diameter Tests

Depth (ft)	$\phi'_{p,tc}$ (deg)	$s_{u,CIUC}$ (psi)	$\phi'_{p,te}$ (deg)	$s_{u,CKoUE}$ (psi)
2.5	41	N/A[a]	46	N/A
5.0	66	5.1	74	2.5
14.5	60	6.0	67	3.2
29	36	12	41	9.2
42.5	42	25	47	17
57.5	28	16	31	13

[a]N/A = Not applicable

Table 6-3. Triaxial Compression and Triaxial Extension Strength Parameters from 6 in. Diameter Tests

Depth (ft)	$\phi'_{p,tc}$ (deg)	$s_{u,CIUC}$ (psi)	$\phi'_{p,te}$ (deg)	$s_{u,CKoUE}$ (psi)
5.0	21	2.0	24	1.7
14.5	22	2.0	25	1.7
29	35	3.3	39	2.4
42.5	27	8.6	30	7.0
57.5	45	4.8	50	3.0

6.6 Cone Penetration Testing Data

Currently, there are various equations and methods that can be used to determine both the undrained shearing strength (s_u) and effective friction angle (ϕ') of soils from CPT results. The simplest method to determine s_u from CPT data is the cone bearing factor (N_{kt}) method described in Kullhawy and Mayne (1990) and presented in Eq. 6-15. The value for N_{kt} was assumed to be 15 for the Lake Bonneville deposits established from previous correlations. Three methods were used to obtain effective stress friction angles, which are referenced in Robertson and Campanella (1983), Kulhawy and Mayne (1990), and Mayne (2007), and are presented as Eq. 6-16 through Eq. 6-18, respectively.

$$s_{u,CIUC} = \frac{q_t - \sigma_{v0}}{N_{kt}} \qquad \text{Eq. 6-15}$$

$$\phi'_{tc} = \tan^{-1}\left\{\frac{1}{2.68} * \left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]\right\} \qquad \text{Eq. 6-16}$$

$$\phi'_{tc} = \tan^{-1}\left[1 + 0.38\log\left(\frac{q_c}{\sigma'_{vo}}\right)\right] \qquad \text{Eq. 6-17}$$

$$\phi_{tc}' = 17 + 11 * \log\left(\frac{q_t}{\sigma'_{vo}}\right) \qquad \text{Eq. 6-18}$$

As discussed in the previous sections, the shear strength properties typically used to model the actual stress path of lateral compression corresponding to a typical laterally loaded shaft are those based on axial extension stress paths, which simulate the actual lateral compression stress path. The method to obtain $s_{u,CKoUE}$ values from the $s_{u,CIUC}$ values is referenced in Kulhawy and Mayne (1990) and presented as Eq. 6-19 through Eq. 6-22.

$$\left(\frac{s_u}{\sigma'_v}\right)_{CKoUE} = a_{test} \cdot a_{rate} \cdot a_{OCR} \cdot \left(\frac{s_u}{\sigma'_v}\right)_{CIUC} \qquad \text{Eq. 6-19}$$

$$a_{test} = 0.56 - 0.0046 \cdot \phi'_{tc} \qquad \text{Eq. 6-20}$$

$$a_{rate} = 1 + 0.1 \cdot \log \varepsilon' \qquad \text{Eq. 6-21}$$

$$a_{OCR} = OCR^{\Lambda} \qquad \text{Eq. 6-22}$$

where: ϕ'_{tc} is effective stress triaxial compression peak friction angle, ε' is the reference strain in (%/hr) taken to be 1 %/hr, and A is 0.82 for CKoUE conditions. The OCR values were developed using Eq. 6-23 and Eq. 6-24 from the Ozer (2005) method to estimate values of the preconsolidation stress, ϕ'_p, which is based on CPT tip resistance (q_t) and was developed specifically for Lake Bonneville clays.

$$\frac{\sigma'_p}{p_A} = 0.6323\left(\frac{\sigma_v}{p_A}\right)^{0.565}\left(\frac{q_t - \sigma_v}{p_A}\right) \qquad \text{Eq. 6-23}$$

$$OCR = \frac{\sigma'_p}{\sigma_v} \qquad \text{Eq. 6-24}$$

The axial compression effective stress friction angles, f'_{tc}, that were developed using the CPT data were transformed into effective stress axial extension friction angles, f'_{te}, using Eq. 6-25 from Kulhawy and Mayne (1990). The results for undrained shearing strength and effective friction angle developed from the CPT data are presented in Table 6-4 through Table 6-6.

$$\phi'_{te} = 1.12\phi'_{tc} \qquad \text{Eq. 6-25}$$

6.7 Becker Hammer Testing Data

As discussed in Section 2.3 and Section 4.5, Becker hammer tests were performed at the subject site in an attempt to acquire more reliable penetration test results than that of the SPT tests previously performed. The Becker hammer is typically ideal for the gravelly nature of the soil encountered at the Tremonton site.

The data from the BPT tests were reduced in accordance to the methods described in Harder and Seed (1986) and Sy and Campanella (1994) to determine the normalized and corrected SPT blow count $(N_1)_{60}$. The values of $(N_1)_{60}$ can be then used in Eq. 6-26 as recommended by Chen (2004), to obtain first-order estimation of drained friction angles in triaxial compression (ϕ'_{tc}) in sands and gravels as presented in Table 6-7 and Table 6-8, respectively.

$$\phi'_{tc} = 27.5 + 9.2\log[(N_1)_{60}] \qquad \text{Eq. 6-26}$$

Table 6-4. Strength Parameter Results from CPT-01 at the Tremonton Site

Layer	Top Depth (ft)	Bottom Depth (ft)	$s_{u,CIUC}$ (tsf)	s_{u,CK_oUE} (tsf)	ϕ'_{tc} (deg)	ϕ'_{te} (deg)
1	0.0	5.0	4.9	7.4	47	52
2	5.0	10.0	20.8	34.4	48	54
3	10.0	22.5	27.3	36.3	46	51
4	22.5	30.0	24.3	27.7	43	48

Table 6-5. Strength Parameter Results from CPT-02 at the Tremonton Site

Layer	Top Depth (ft)	Bottom Depth (ft)	$s_{u,CIUC}$ (tsf)	s_{u,CK_oUE} (tsf)	ϕ'_{tc} (deg)	ϕ'_{te} (deg)
1	0.0	5.0	5.1	7.7	46	52
2	5.0	10.0	18.7	30.2	48	54
3	10.0	22.5	27.5	36.6	46	52
4	22.5	30.0	23.9	26.7	44	50
5	30.0	37.5	40.7	48.0	45	50

Table 6-6. Strength Parameter Results from CPT-03 at the Tremonton Site

Layer	Top Depth (ft)	Bottom Depth (ft)	$s_{u,CIUC}$ (tsf)	s_{u,CK_oUE} (tsf)	ϕ'_{tc} (deg)	ϕ'_{te} (deg)
1	0.0	5.0	3.9	5.7	45	50
2	5.0	10.0	19.0	32.0	49	55

Table 6-7. Results of the Harder and Seed (1986) Method

Layer	Top Depth (ft)	Bottom Depth (ft)	ϕ'_{tc} (deg)	ϕ'_{te} (deg)
1	0.0	5.0	41	46
2	5.0	10.0	42	47
3	10.0	22.5	43	49
4	22.5	30.0	46	52

Table 6-8. Results of the Sy and Campanella (1994) method

Layer	Top Depth (ft)	Bottom Depth (ft)	ϕ'_{tc} (deg)	ϕ'_{te} (deg)
1	0.0	5.0	46	51
2	5.0	10.0	46	52
3	10.0	22.5	45	50
4	22.5	30.0	43	48

The results determined from the Sy and Campanella method were chosen as input parameters for *LPILE* over the Harder and Seed method due to the more extensive research of Sy and Campanella. The evaluation of the BPT measurements also showed the need for a correction resulting from the increase in casing friction and its effects on the conversion to SPT blow counts (Sy and Campanella, 1994).

6.8 Summary

Data reduction of the field and laboratory test results were presented in this chapter. Data were reduced to properly classify the subsurface material at the subject site and provide shear strength results for comparison in achieving the overall goal of being able to determine the best representation of strength and deformation characteristics of the transitional heterogeneous subsurface material at the Tremonton site.

7 EFFECTS OF SAMPLE SIZE ON TRIAXIAL RESULTS

7.1 Overview

In geotechnical practice, triaxial tests are often performed on 2.8 in. diameter samples and can be trimmed down to size or reconstituted in a sample mold to fit the dimensions of the apparatus being used to perform the tests. Per ASTM D4767, it is recommended to remove all particles greater than one-sixth of the diameter of the sample being tested. This is approximately 0.5 in. for the standard 2.8 in. sample diameter test. Such a recommendation may significantly change the soil matrix of reconstituted samples from the Tremonton site due to the larger particle sizes found therein. Hence, reconstituted 2.8 in. diameter samples may provide shear strength results that are not representative of the in-situ shear strength of the soil. Therefore, larger (6 in.) diameter triaxial tests were performed in conjunction with smaller (2.8 in.) diameter triaxial tests for comparison to determine whether the larger diameter tests would produce differing, and perhaps more representative shear strength results. Using the larger diameter sample mold, particles up to approximately 1 in. in diameter were incorporated, which provided a better representation of the actual particle size being encountered at the site.

A similar investigation was performed in Singapore. Chew and Bharati (2011) performed triaxial compression tests on trimmed, marine samples with diameters of approximately 1.5 in. and 8 in. (see Section 2.2). When comparing the results of the small and large diameter tests, they reported reduced undrained shear strength results from the larger diameter tests when compared to the smaller diameter tests. The large diameter tests had shear strengths that were up to 70% less than those of smaller diameter tests. They concluded that the reduction in shear strength could be due to the increased presence of nonuniformity and nonhomogeneity in the field, which was captured in the larger diameter samples, but was not present in the smaller diameter samples.

7.2 Shear Strength Test Results

In order to compare potential differences in shear strength results acquired from the small and large diameter tests performed for this study (Section 5.2), plots of deviatoric stress versus axial strain were constructed and shown as Fig. 7-1 through Fig. 7-5.

These figures clearly show that smaller diameter triaxial tests produced significantly higher deviatoric stresses. The maximum difference between the small and large diameter samples were about 65% to 75%. In addition, the initial slopes of the smaller diameter tests were also significantly steeper, indicating a stiffer sample with a higher intial modulus. The results for the peak internal friction angle and undrained shear strength are shown in Table 7-1. Reviewing the results in terms of peak internal friction angle between the tests, there was a reduction of 68%, 63%, and 36% in the testing depths of approximately 5 ft, 14.5 ft, and 42.8 ft, respectively.

For the testing depth of 29 ft, the peak internal friction angle came out nearly the same with results of 36 degrees and 35 degrees for the 2.8-inch diameter test and the 6 in. diameter test, respectively. The results for the depth of 57.5 ft. resulted in a 38% increase in peak internal friction angle for the larger diameter test compared to the smaller diameter test. Comparing the results of the two diameter tests in terms of undrained shear

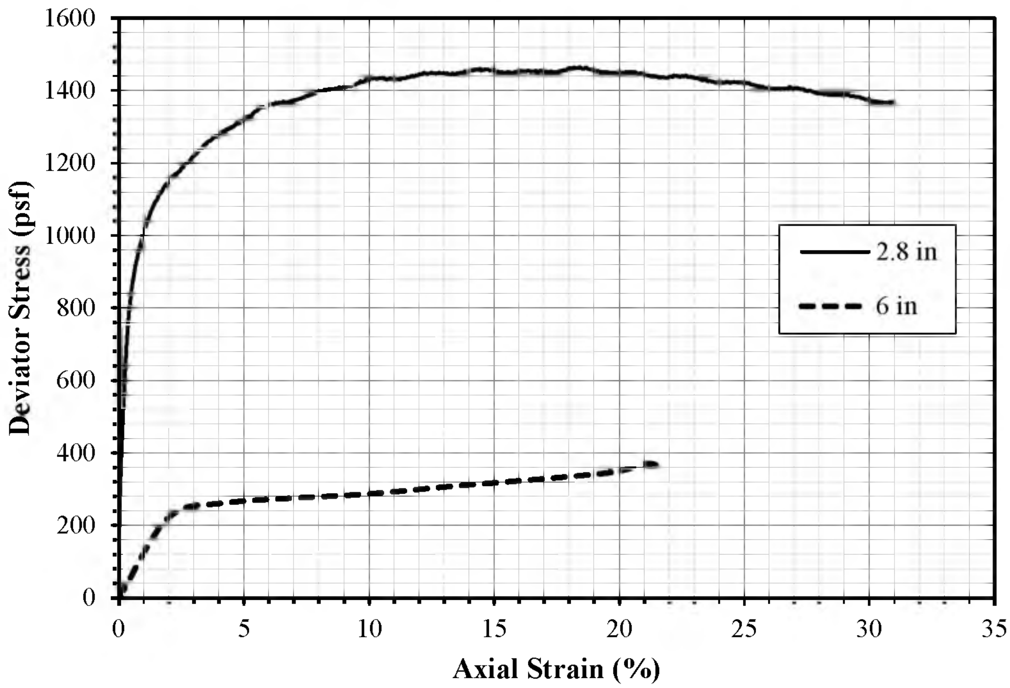

Fig. 7-1. Deviatoric stress versus axial strain of 2.8 in. and 6 in. diameter triaxial compression tests for sample taken at a depth of 5 ft

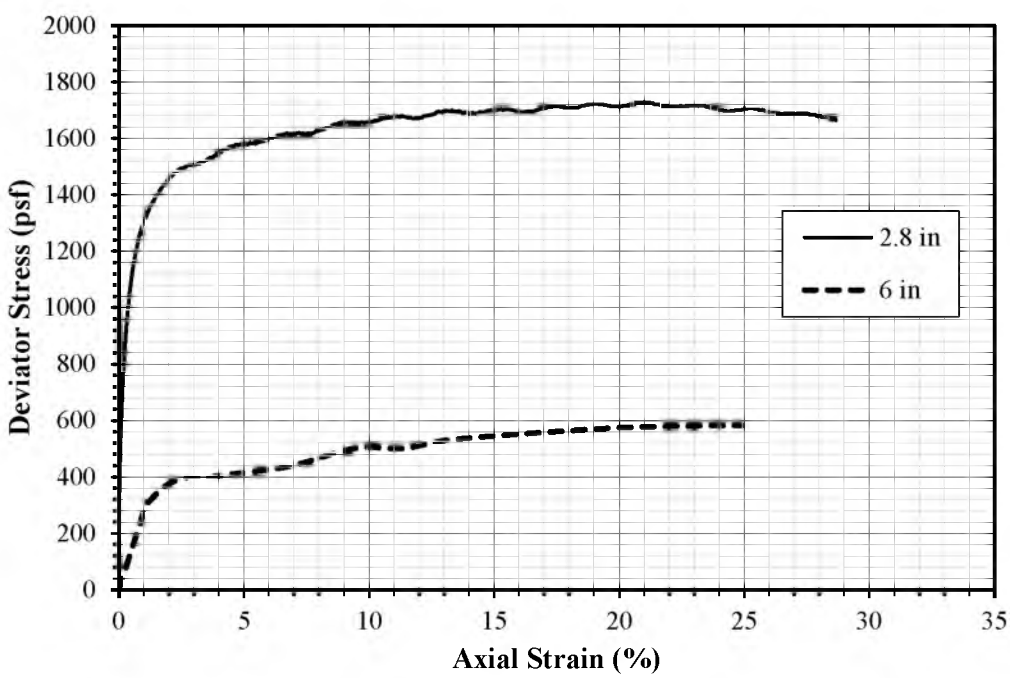

Fig. 7-2. Deviatoric stress versus axial strain of 2.8 in. and 6 in. diameter triaxial compression tests for sample taken at a depth of 14.5 ft

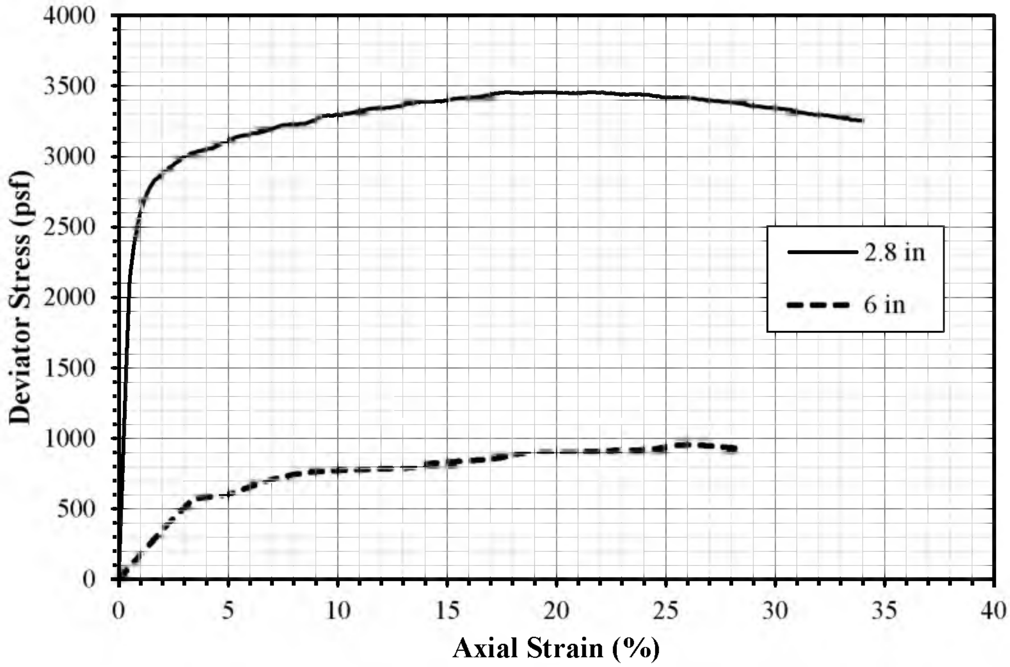

Fig. 7-3. Deviatoric stress versus axial strain of 2.8 in. and 6 in. diameter triaxial compression tests for sample taken at a depth of 29 ft

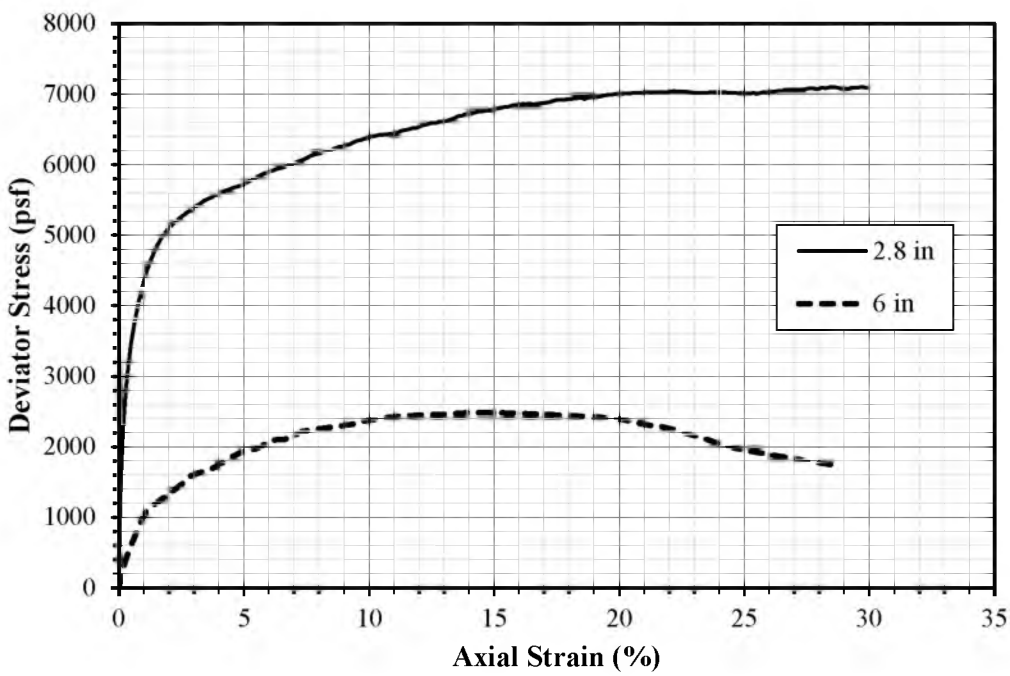

Fig. 7-4. Deviatoric stress versus axial strain of 2.8 in. and 6 in. diameter triaxial compression tests for sample taken at a depth of 42.8 ft

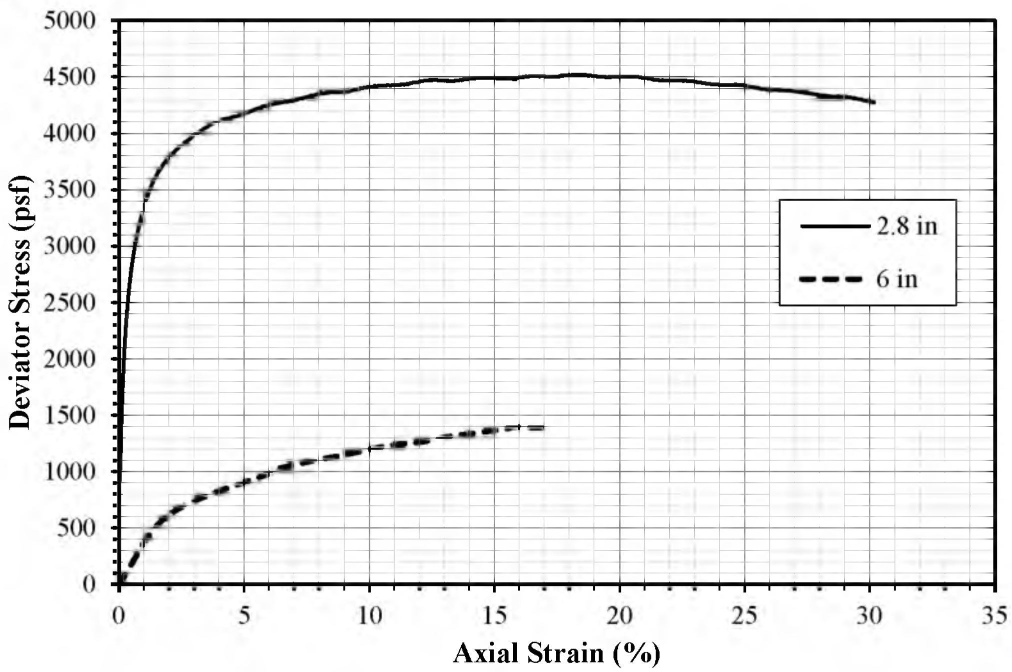

Fig. 7-5. Deviatoric stress versus axial strain of 2.8 in. and 6 in. diameter triaxial compression tests for sample taken at a depth of 57.5 ft

Table 7-1. Strength Results from 2.8 in. and 6 in. Diameter Triaxial Compression Tests

	2.8 in.		6 in.	
Depth (ft)	ϕ'_p (deg)	s_u (psi)	ϕ'_p (deg)	s_u (psi)
2.5	41	N/A	N/A	N/A
5.0	66	5	21	2
14.5	60	6	22	2
29.0	36	12	35	3
42.8	42	25	27	9
57.5	28	16	45	5

strength, all testing depths resulted in reductions for the larger diameter tests ranging from 61% to 73% when compared to those of the smaller diameter tests.

In comparing the results of this study to that of Chew and Bharati (2011), both studies recorded reductions in the maximum deviatoric stress for the larger diameter samples. In addition, both studies showed reductions in the resulting undrained shear strengths for the larger diameter samples. One point that stood out from the this study was the fact that not all larger diameter triaxial compression tests produced reductions in peak internal friction angles when compared with the smaller diameter tests. Even though the Chew and Bharati (2011) study had no peak internal friction angle values to compare with this study, it is likely that the larger diameter tests would produce lower peak friction angle values considering the results of both studies.

Initially, it was believed that the addition of larger particles for the larger diameter tests would result in increased shear strength values compared to the smaller diameter tests. However, considering that the samples had to be reconstituted in a sample mold, there might have been an increase in voids in the soil compared to in-situ conditions; even in the smaller diameter tests. If that were the case, the larger diameter samples would have significantly larger voids resulting in a subsequent decrease in shear strength. As discussed in the investigation by Chew and Bharati (2011), the larger samples captured a more accurate representation of the nonhomogeneity and nonuniformity of the soil than that of the smaller samples. However, an argument could be made that the increase in heterogeneity of the samples could be increased depending on the type of soil. For example, sand seams in a clay dominated sample could increase the strength of the sample overall.

Another possible reason for the increased shear strength values in the smaller diameter samples is discussed in Sheng et al., (1997), and explains the added effects of end restraint on the sample during undrained shear. As summarized in their study, “end restraint” or end friction acts as additional confinement at the ends of a specimen due to membranes, o-rings, and platens, preventing the soil from moving outwards freely and inducing shear stress. Visually, the presence of end effects can be seen by the barrel-shaped deformation of the sample during the shearing portion of the triaxial test. Barrel-shaped deformation was present in all samples tested in this study, as shown in Figure 5-10.

It is believed that the effects of end restraint would have a more significant impact on smaller diameter samples resulting in an increase in effective confining stress. Therefore, it is recommended that more research and testing be completed to quantify and compare the effects of sample size. Numerous triaxial compression tests with varying sample diameters should be carried out to acquire a statistical representation of results and gain a more complte understanding of sample size effects and their impacts on the strength of the transitional soil. This research should include samples with and without larger diameter particles. The present study compared small diameter samples, with the larger particles removed, against larger diameter samples with more of the larger particles included. Future research should compare tests of different sample size, but with the same grain size distribution in the sample. In addition, it is recommended that additional triaxial tests be performed with strain gauges in the center of the sample to reduce the effects of end restraint.

7.3 Summary

This chapter discussed the results of small (2.8 in.) diameter and large (6 in.) diameter triaxial compression tests performed for the present study from samples obtained from the Tremonton site. Results of the present study were compared to those of a similar study, which explored the differences in shear strength as a function of specimen diameter. Possible hypotheses for the significant reduction in shear strength observed for the larger diameter tests were provided. In addition, recommendations were made for further research and testing to obtain a statistical sampling of the results using triaxial tests on samples of various diameters.

8 EVALUATION OF ANALYTICAL METHODS

8.1 Overview

As stated in the introduction, this study is based on investigations funded by PacifiCorp and is intended to provide a detailed geotechnical investigation for the design and analysis of deep, drilled shaft foundations for transmission line structures. The details of that study included preliminary geological investigations, field and laboratory testing to determine geotechnical shear strength properties, and finally, analysis and design of those drilled shaft foundations. The resulting drilled shaft designs based on various testing procedures were then compared geometrically and fiscally to the previous design and constructed drilled shafts at the site with the intent of exploiting the benefits of a complete detailed geotechnical investigation for any proposed construction.

The software program *LPILE* was used for the analysis and design of the drilled shafts, which uses discrete nonlinear springs to model the *P-y* reactions of the soil against the lateral loading of the shaft. Several analyses were completed using the shear strength properties and deformation behavior determined from various field and laboratory tests. The soil types utilized were "Stiff Clay without Free Water" and "Sands (Reese)," which are based on the methods provided by Welch and Reese (1972), and Reese (1974), respectively. *LPILE* also allows the user to input *P-y* curves manually, which was done for the subsequent analyses based on the curves determined from the PMT data.

The *LPILE* analyses were performed in accordance with PacifiCorp's design standard TA-071, which provides the required design criteria. Each analyses was completed assuming the following material characteristics:

- Compressive strength of concrete, f'_c = 4,000 psi
- Yield stress of reinforcing steel, f_y = 60,000 psi
- Young's modulus of steel, E_{st} = 29,000,000 psi

The design loads used in each analysis are shown in Table 8-1. The serviceability load case was used to check the lateral deflection and rotation of the shaft to confirm that it met the criteria of the design standard. The allowable ground-line deflection (y_{GL}) and ground-line rotation (θ_{GL}) were calculated to be 2.3 in. and 0.59 degrees, respectively. These allowable deformation criteria were based on the assumption that the permanent deformations resulting from the loading are taken to be 0.85 times the allowable; which the design standard lists maximum values of 2.0 in. of ground-line deflection and 0.50 degrees of ground-line rotation. The ultimate load case includes overload capacity factors used to check the structural reinforcement within the concrete shaft.

The drilled shaft foundation currently in place at the subject site was designed by a separate geotechnical consulting firm and was constructed with an 11 ft diameter by 50 ft deep shaft, reinforced with 101 #10 bars. The minimum diameter of 11 ft was kept constant in all other analyses. The analyses performed using the strength and deformation parameters determined from the other various field and laboratory tests will be evaluated against the results of the analyses performed using the pressuremeter data.

A comparison will be made of the required shaft lengths needed for the design to conform to the criteria stated in the design standard. In addition, the methods proposed

Table 8-1. Serviceability and Ultimate Design Loads for *LPILE* Analyses

Load Case	Axial, P_a (kips)	Lateral, V_L (kips)	Moment, M_t (kip-ft)
1 - Serviceability	117	222	19,594
2 – Ultimate	119	320	28,754

by Welch and Reese (1972), and Reese (1974), to construct *P-y* curves for the soil types "Stiff Clay without Free Water" and "Sands (Reese)," will be compared against the *P-y* curves developed from the pressuremeter data.

8.2 *LPILE* Analysis Using *P-y* Curves Developed from Pressuremeter Data

An *LPILE* analysis was performed using the *P-y* curves developed in Section 6.2 constructed from the pressuremeter data obtained in the geotechnical field investigation. The *P-y* curves were adjusted for the top and bottom of each layer corresponding to the *P-y* curve within that layer using the mean effective stress. The results and input of each layer needed for the *LPILE* analysis after being adjusted for the increase in stiffness is presented in the output file in Appendix B. As presented in Table 8-2, the *LPILE* analysis using the *P-y* curves resulted in a required shaft length of 40 ft. This required shaft depth was determined and was kept within the requirements of TA 071. A plot of lateral shaft deflection versus depth determined from the *LPILE* analysis is presented in Fig. 8-1.

It should also be pointed out that if the pressuremeter tests had been performed up to geotechnical failure so that the net limit pressure P_L* could have been determined, more correlations could have been used in conjunction with the pressuremeter data to

Table 8-2. *LPILE* Design Results using the Pressuremeter Data

Parameter	Value
D_S	11 ft
L_S	40 ft
Long. Reinforcement	90 #10 bars
$M_{u,max}$	30,600 kip-ft
y_{GL}	1.86 in.
θ_{GL}	0.54 deg

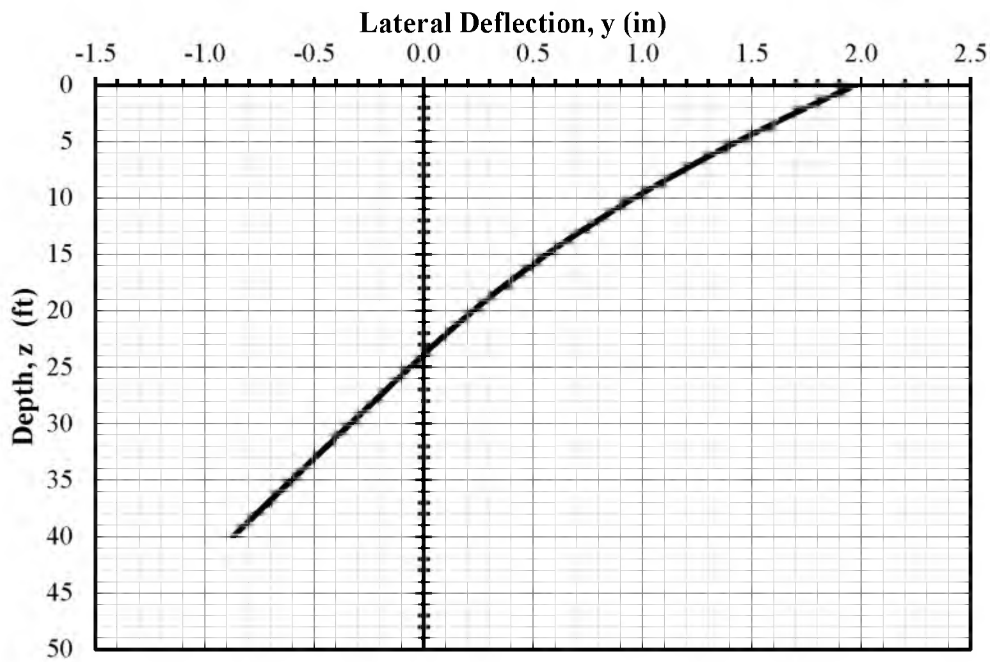

Fig. 8-1. Lateral deflection versus depth from *LPILE* using the *P-y* curves determined from PMT results

obtain other strength parameters of the soil including ϕ'_p and s_u. This result would have permitted additional analyses to be performed with *LPILE* using internal correlations to develop the *P*-*y* curves.

8.3 *LPILE* Analysis Using Results Determined from Triaxial Tests

Four *LPILE* analyses were conducted using the triaxial results discussed in Section 6.3. It must be noted that the maximum friction angle that can be used in *LPILE* is 48 degrees, thus those layers with higher friction angles were lowered to the 48 degree value in the analysis. In the same respect, the lowest value of undrained shear strength that will be accepted in *LPILE* is 3.48 psi. Therefore, this lower bound value was used as the undrained shear strength in the layers that had lower values.

The first analysis was performed using the effective friction angles determined from the 2.8 in. diameter triaxial tests, which were adjusted from triaxial compression friction angles to triaxial extension friction angles. The second analysis was completed using the correlated triaxial extension undrained shear strengths determined from the 2.8 in. diameter test. The third analysis was performed using the effective friction angles determined from the 6 in. diameter tests, which were correlated from triaxial compression friction angles to triaxial extension friction angles. The fourth analysis was completed using the correlated triaxial extension undrained shear strengths determined from the 6 in. diameter test.

The layering and shear strength inputs that were used for the *LPILE* analyses are presented in Table 8-3, Table 8-4, Table 8-5, and Table 8-6 for the analyses, respectively.

Table 8-3. *LPILE* Input Using the Peak Friction Angles from 2.8 in. Diameter Triaxial Tests

Starting Depth (in)	Ending Depth (in)	Soil Model	Effective Unit Weight, γ (pci)	Peak Friction Angle, ϕ'_p (deg)
42	72	Sand (Reese)	0.053	46
72	132	Sand (Reese)	0.073	74
132	282	Sand (Reese)	0.067	67
282	396	Sand (Reese)	0.070	41
396	462	Sand (Reese)	0.069	41
462	672	Sand (Reese)	0.071	47
672	732	Sand (Reese)	0.072	31
732	1200	Sand (Reese)	0.071	31

Table 8-4. *LPILE* Input using the Undrained Shear Strengths from 2.8 in. Diameter Tests

Starting Depth (in)	Ending Depth (in)	Soil Model	Effective Unit Weight, γ (pci)	Undrained Shear Strength, $s_u(CK_oUE)$ (psi)	Peak Friction Angle, ϕ'_p (deg)
42	72	Sand (Reese)	0.053	N/A[b]	41
72	132	Stiff Clay w/o FW[a]	0.073	2.4	N/A
132	282	Stiff Clay w/o FW	0.067	3.2	N/A
282	396	Stiff Clay w/o FW	0.070	9.2	N/A
396	462	Stiff Clay w/o FW	0.033	9.2	N/A
462	672	Stiff Clay w/o FW	0.035	17	N/A
672	732	Stiff Clay w/o FW	0.036	13	N/A
732	1200	Stiff Clay w/o FW	0.035	17	N/A

[a]FW = Free water or groundwater table conditions.
[b]N/A = Not applicable

Table 8-5. *LPILE* Input using the Peak Friction Angles from 6 in. Diameter Tests

Starting Depth (in)	Ending Depth (in)	Soil Model	Effective Unit Weight, γ (pci)	Peak Friction Angle, ϕ'_p (deg)
42	72	Sand (Reese)	0.053	46
72	132	Sand (Reese)	0.073	24
132	282	Sand (Reese)	0.067	25
282	396	Sand (Reese)	0.070	39
396	462	Sand (Reese)	0.069	39
462	672	Sand (Reese)	0.071	50
672	732	Sand (Reese)	0.072	39
732	1200	Sand (Reese)	0.071	50

Table 8-6. *LPILE* Input using the Undrained Shear Strengths from 6 in. Diameter Tests

Starting Depth (in)	Ending Depth (in)	Soil Model	Effective Unit Weight, γ (pci)	Undrained Shear Strength, $s_u(CK_oUE)$ (psi)	Peak Friction Angle, ϕ'_p (deg)
42	72	Sand (Reese)	0.053	N/A[b]	41
72	132	Stiff Clay w/o FW[a]	0.073	2.0	N/A
132	282	Stiff Clay w/o FW	0.067	2.0	N/A
282	396	Stiff Clay w/o FW	0.070	7.5	N/A
396	462	Stiff Clay w/o FW	0.033	7.5	N/A
462	672	Stiff Clay w/o FW	0.035	7.0	N/A
672	732	Stiff Clay w/o FW	0.036	3.0	N/A
732	1200	Stiff Clay w/o FW	0.035	7.0	N/A

[a]FW = Free water or groundwater table conditions.

[b]N/A = Not applicable

A tabulated summary of the results for each of the respective analyses are presented in Table 8-7, Table 8-8, Table 8-9, and Table 8-10. In addition, a plot of lateral defelction versus depth for each of the analyses is presented in Fig. 8-2, Fig. 8-3, Fig. 8-4, and Fig. 8-5, respectively.

8.4 *LPILE* Analysis Using Results Determined from Cone Penetration Data

Two analyses were performed using strength parameters obtained using the CPT data. The *LPILE* input for the drained analysis using peak friction angles and the undrained analysis using undrained shearing strengths are shown in Table 8-11 and Table 8-12, respectively. It must be noted that the maximum friction angle that can be used in *LPILE* is 48 degrees, thus those layers with higher friction angles were lowered to the 48 degree value in the analysis. In the same respect, the highest value of undrained shear strength that will be accepted in *LPILE* is 55.55 psi. Therefore this upper bound value was used as the undrained shear strength in the layers that had higher values. The design results are given in Table 8-13 and Table 8-14, respectively. Results of lateral deflection versus depth for these analyses are presented in Fig. 8-6 and Fig. 8-7, respectively.

8.5 *LPILE* Analysis Using Results Determined from Becker Penetration Data

An *LPILE* analysis was performed using the peak effective stress triaxial extension friction angles obtained from the Becker Penetrations tests as described in Section 4.5. The *LPILE* input for this analysis is presented in Table 8-15. It must be noted that the

Table 8-7. *LPILE* Design Results using the Peak Friction Angles from 2.8 in. Diameter Triaxial Tests

Parameter	Value
D_S	11 ft
L_S	30 ft
Long. Reinforcement	100 #10 bars
$M_{u,max}$	30,700 kip-ft
y_{GL}	1.20 in.
θ_{GL}	0.40 deg

Table 8-8. *LPILE* Design Results using the Undrained Shear Strengths from the 2.8 in. Diameter Triaxial Tests

Parameter	Value
D_S	11 ft
L_S	70 ft
Long. Reinforcement	100 #10 bars
$M_{u,max}$	31,100 kip-ft
y_{GL}	2.23 in.
θ_{GL}	0.51 deg

Table 8-9. *LPILE* Design Results using the Peak Friction Angles from the 6 in. Diameter Triaxial Tests

Parameter	Value
D_S	11 ft
L_S	40 ft
Long. Reinforcement	90 #10 bars
$M_{u,max}$	30,800 kip-ft
y_{GL}	2.04 in.
θ_{GL}	0.52 deg

Table 8-10. *LPILE* Design results using the Undrained Shear Strengths from the 6 in. Diameter Triaxial Tests

Parameter	Value
D_S	11 ft
L_S	95 ft
Long. Reinforcement	90 #11 bars
$M_{u,max}$	30,800 kip-ft
y_{GL}	2.16 in.
θ_{GL}	0.48 deg

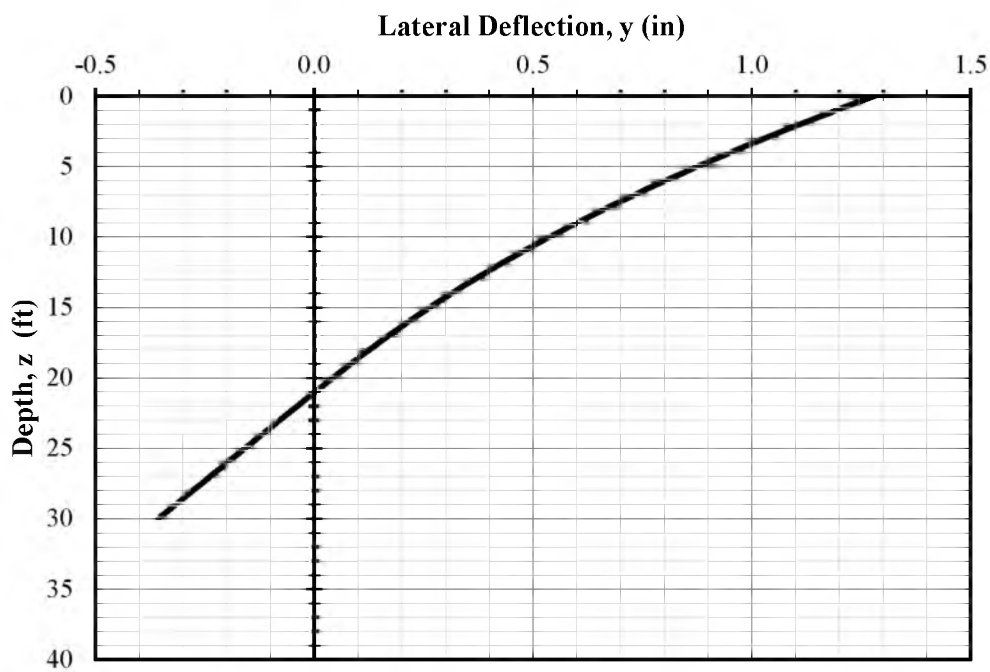

Fig. 8-2. Lateral deflection versus depth from *LPILE* using the peak friction angle results from the 2.8 in. diameter triaxial tests

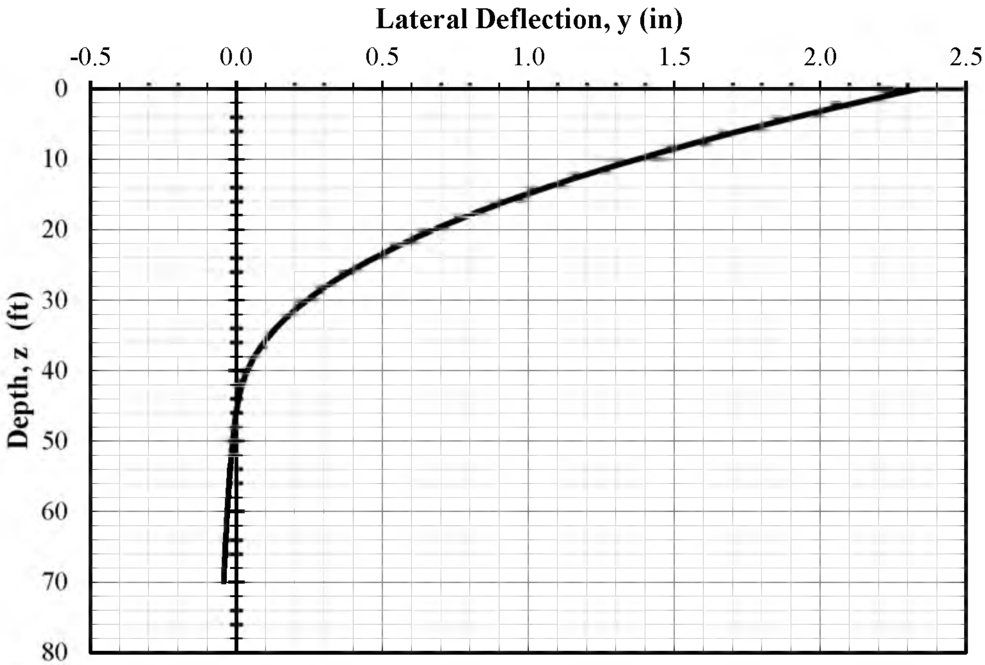

Fig. 8-3. Lateral deflection versus depth from *LPILE* using the undrained shear strength results from the 2.8 in. diameter triaxial tests

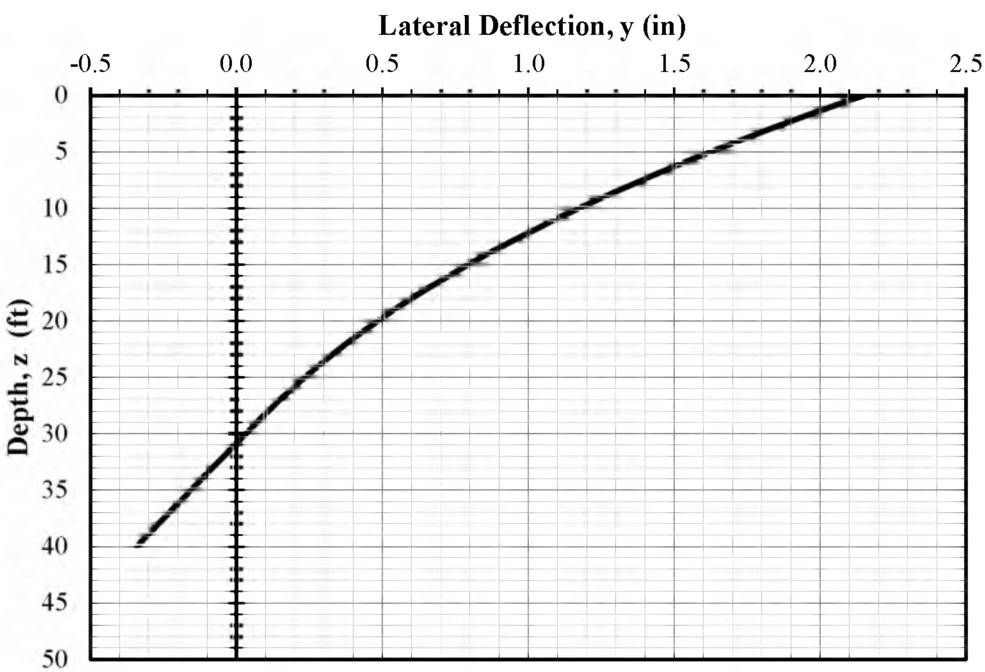

Fig. 8-4. Lateral deflection versus depth from *LPILE* using the peak friction angle results from the 6 in. diameter triaxial tests

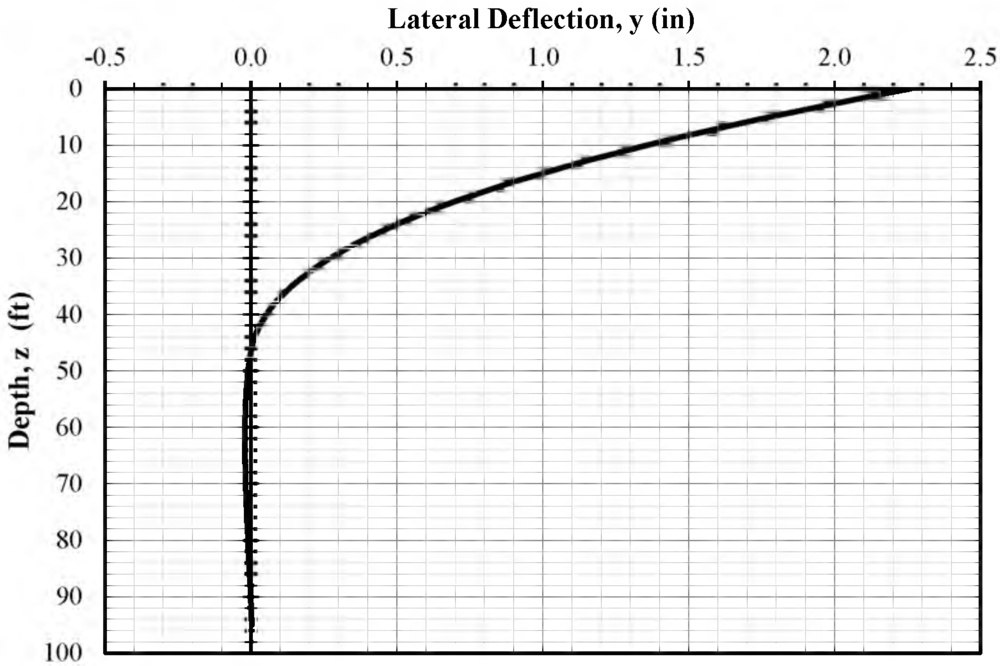

Fig. 8-5. Lateral deflection versus depth from *LPILE* using the undrained shear strength results from the 6 in. diameter triaxial tests

Table 8-11. Layering and Friction Angle Input for the *LPILE* Analysis Based on CPT Data

Starting Depth (in)	Ending Depth (in)	Soil Model	Effective Unit Weight, γ (pci)	Peak Friction Angle, ϕ'_p (deg)
42	72	Sand (Reese)	0.053	46
72	132	Sand (Reese)	0.073	52
132	282	Sand (Reese)	0.067	54
282	396	Sand (Reese)	0.070	49
396	462	Sand (Reese)	0.069	50

Table 8-12. Layering and Undrained Shear Strength Input for the *LPILE* Analysis Based on CPT Data

Starting Depth (in)	Ending Depth (in)	Soil Model	Effective Unit Weight, γ (pci)	Undrained Shear Strength, s_u (psi)	Peak Friction Angle, ϕ'_p (deg)
42	72	Sand (Reese)	0.053	N/A[b]	46
72	132	Stiff Clay w/o FW[a]	0.073	447	N/A
132	282	Stiff Clay w/o FW	0.067	507	N/A
282	396	Stiff Clay w/o FW	0.070	378	N/A
396	462	Stiff Clay w/o FW	0.031	667	N/A

[a]FW = Free water or groundwater table conditions.

[b]N/A = Not applicable

Table 8-13. *LPILE* Design Results using Friction Angles Obtained from CPT Results

Parameter	Value
D_S	11 ft
L_S	28 ft
Long. Reinforcement	90 #10 bars
$M_{u,max}$	30,700 kip-ft
y_{GL}	1.56 in.
θ_{GL}	0.52 deg

Table 8-14. *LPILE* Design Results using Undrained Shear Strengths from CPT Results

Parameter	Value
D_S	11 ft
L_S	32 ft
Long. Reinforcement	90 #10 bars
$M_{u,max}$	30,400 kip-ft
y_{GL}	1.41 in.
θ_{GL}	0.48 deg

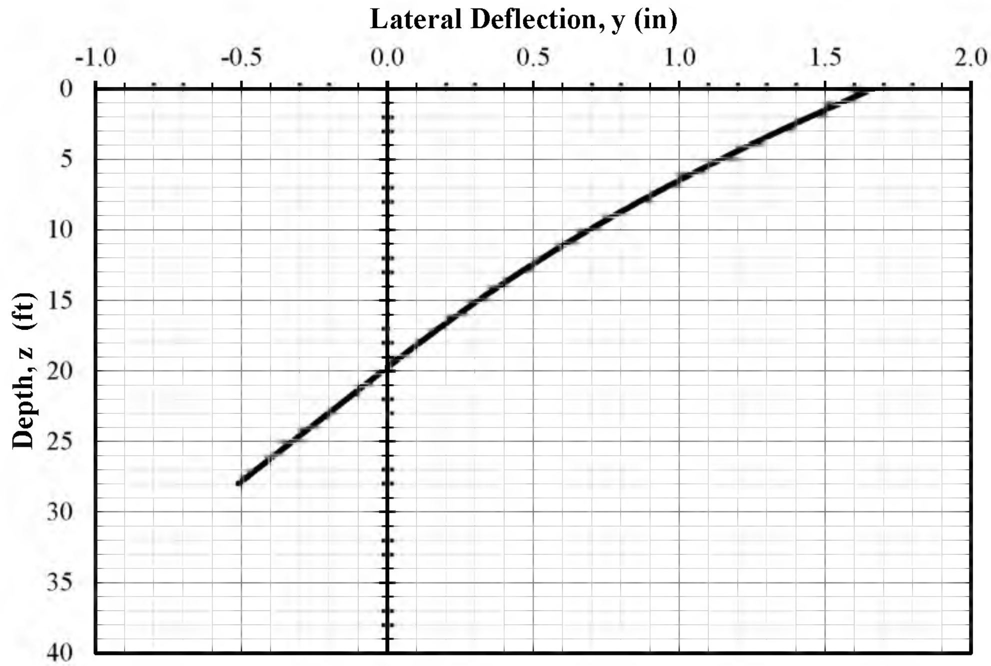

Fig. 8-6. Lateral deflection versus depth from *LPILE* using friction angles obtained from CPT

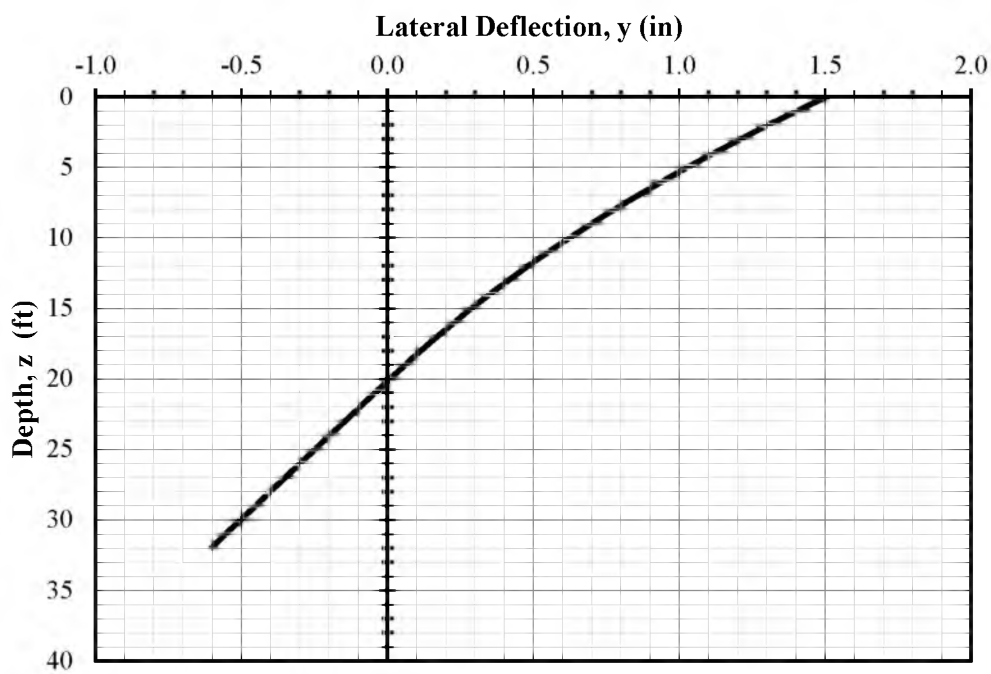

Fig. 8-7. Lateral deflection versus depth from *LPILE* using undrained shearing strengths obtained from CPT

Table 8-15. Strength Parameters and Layering Input for *LPILE* Analysis Based on Becker Penetration Tests

Starting Depth (in)	Ending Depth (in)	Soil Model	Effective Unit Weight, γ (pci)	Peak Friction Angle, ϕ'_p (deg)
42	72	Sand (Reese)	0.053	46
72	132	Sand (Reese)	0.073	47
132	282	Sand (Reese)	0.067	49
282	396	Sand (Reese)	0.070	52
396	700	Sand (Reese)	0.069	48

maximum friction angle that can be used in *LPILE* is 48 degrees, thus those layers with higher friction angles were lowered to the 48 degree value in the analysis. The results are given in Table 8-16 and the plot of lateral deflection versus depth is presented in Fig. 8-8.

8.6 Comparison of *LPILE* Results

A summary of the results for the eight methods used to design and analyze the foundation at the Tremonton site are summarized in Table 8-17. All analyses were performed using the minimum shaft diameter of 11 ft. required by the structural dimensions of the transmission line tower. Lateral deflection versus depth curves are presented in Fig. 8-9 for the PMT based analysis and all drained analyses completed for the site. Lateral deflection versus depth curves are presented in Fig. 8-10 for the PMT based analysis and all undrained analyses completed for the site. Becuase the shaft diameter is the same for all designs, and the deflection and rotation criteria were met in all cases, comparisons will be focused on the differing shaft lengths obtained from the eight methods.

Utilizing the *P-y* curves determined from the PMT results along with the program

Table 8-16. *LPILE* Design Results using Friction Angles obtained from Becker Penetration Tests

Parameter	Value
D_S	11 ft
L_S	28 ft
Long. Reinforcement	100 #10 bars
$M_{u,max}$	30,500 kip-ft
y_{GL}	1.50 in.
θ_{GL}	0.50 deg

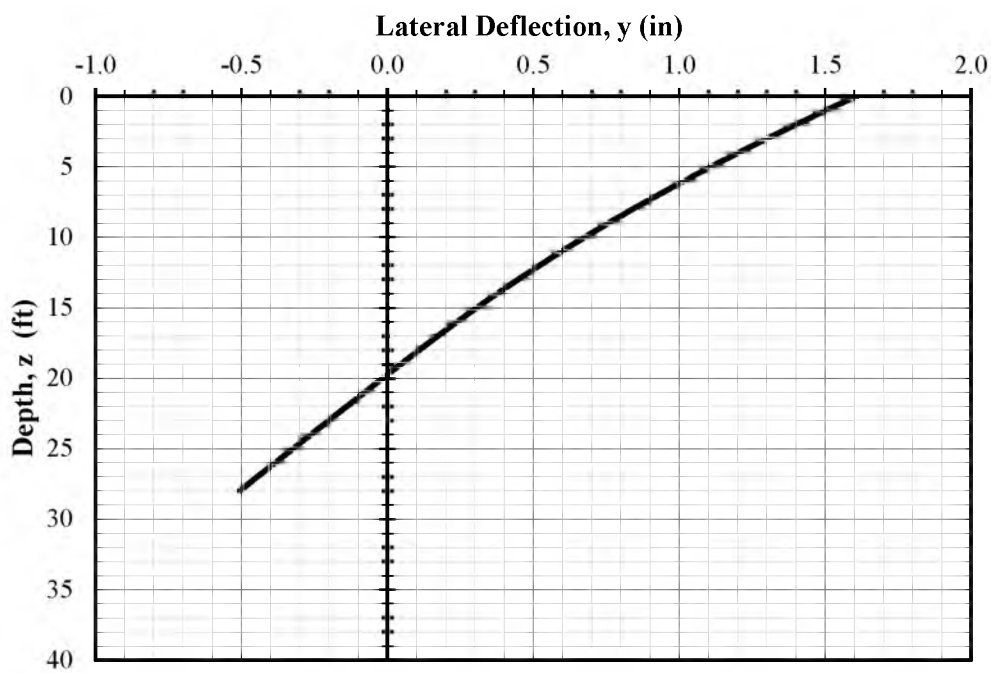

Fig. 8-8. Lateral deflection versus depth from *LPILE* using friction angles obtained from Becker penetration tests

Table 8-17. Design Results from the Various Methods

Method	Diameter, D_S (ft)	Length, L_S (ft)	Ground Line Deflection, y_{GL} (in)	Ground Line Rotation, θ_{GL} (deg)
P-y Curves from PMT	11	40	1.86	0.54
Drained - ϕ' from 2.8 inch TRX	11	30	1.20	0.40
Undrained - s_u from 2.8 inch TRX	11	70	2.23	0.51
Drained - ϕ' from 6 inch TRX	11	40	2.04	0.52
Undrained - s_u from 6 inch TRX	11	95	2.16	0.48
Drained - ϕ' from CPT	11	28	1.56	0.52
Undrained - s_u from CPT	11	32	1.41	0.48
Drained - ϕ' from BPT	11	28	1.50	0.50

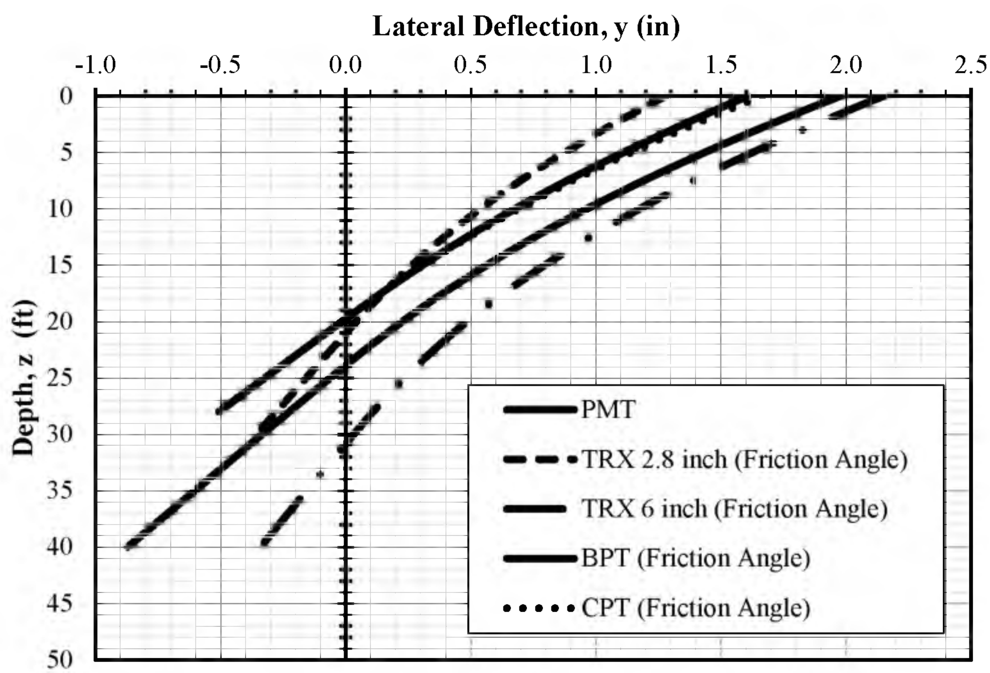

Fig. 8-9. Lateral deflection versus depth comparison design results for all drained analyses against the PMT based analysis

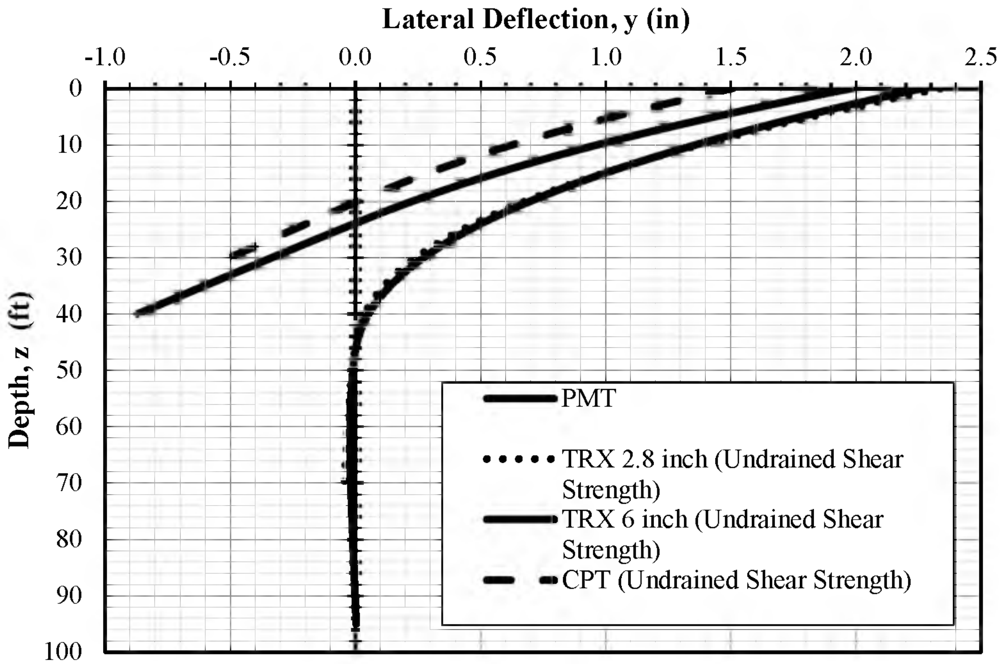

Fig. 8-10. Lateral deflection versus depth comparison design results for all undrained analyses against the PMT based analysis

LPILE, which is assumed at this point to be the most reliable method, produced a shaft length of 40 ft with a ground line deflection of 1.86 inches with 0.54 degrees of ground line rotation. It is important to note that the PMT results indicated drained conditions during each of the PMT tests.

The analyses utilizing the undrained shear strengths determined from the small and large diameter triaxial tests resulted in shaft lengths of 70 ft and 95 ft, respectively, which are much greater than that of the PMT based analysis. The peak internal friction angle based analyses determined from the small and large diameter triaxial tests resulted in shaft lengths of 30 ft and 40 ft, respectively. Therefore, based on these results and sample preparation and testing issues discussed earlier, the results based from triaxial tests are believed to be questionable for the following reasons: (a) scalping of large particles during sample preperation, (b) destruction of natural cementation during reconstitution of the sample, and (c) values of ϕ' were estimated from undrained tests with pore pressure measurements, so the resulting stress levels and stress paths are not consistent with those that would exist in the actual loading condition.

The shaft lengths, determined from the analyses based on the undrained shear strengths and peak internal friction angles derived from the CPT data, were found to be 32 ft and 28 ft, respectively. The analyses based on the peak internal friction angles derived from the BPT data resulted in a shaft length of 28 ft. The results from the CPT and BPT based analyses are to be used with caution becuase the shear strength properties calculated from the CPT and BPT data exceeded the *LPILE* input limits. All of the above methods would be considered acceptable in standard geotechnical practice. However, given the variability in the calculated shaft lengths using the various properties and investigative methods, it is apparent that there is still considerable uncertainly related to methods used to obtain geotechnical strength and compressibility parameters, and with the software programs used for the analyses. Thus, it is highly recommended that full-scale load tests be performed at the site to determine the validity of the analysis completed based on the *P-y* curves derived from the pressuremeter data. Further, such tests would provide additional information regarding the degree of accuracy provided by the other shear strength based methods investigated in this study.

8.7 Comparison of P-y Curves from PMT Data and Analytical Methods

The variability of design results determined by *LPILE* is shown in Fig. 8-9 through Fig. 8-10, with the resulting shaft lengths determined from the different methods varying from a minimum of 28 ft to a maximum of 95 ft. As previously stated, the results determined from the PMT based analysis were considered to be the most reliable of all the analyses performed, which resulted in a required shaft length of 40 ft. This wide range of variability indicates that there must be some significant differences in the *P-y* curves between the different methods. Therefore, *P-y* curves were developed for the depths of 5 ft, 14.5 ft, 29 ft, 42.75 ft, and 57.5 ft, and are presented in Fig. 8-11 through Fig. 8-15 for comparison. The depths were chosen based on the testing depth of the pressuremeter tests. The analytical methods used are those proposed in Welch and Reese (1972), and Reese (1974), which are also implemented in the *LPILE* software.

In each of the comparison figures, the *P-y* curves developed from the pressuremeter are located in the middle range with the *P-y* curves developed from the internal peak friction angle based method producing higher (less conservative) values and the *P-y* curves developed from the undrained shear strength based method producing lower (more conservative) values. These various *P-y* curves according to method clearly explain the variation in design results (Table 8-17). Fig. 8-14 and Fig. 8-15 do not include *P-y* curves from the CPT or BPT derived analyses because both in-situ testing methods were terminated at a depth of approximately 30 ft due to the exceedance of the capacity of each respective rig.

The data obtained from the PMT is considered the most reliable method of estimating lateral deformation. This is because this test is performed in-situ and the device reacts laterally against the undisturbed soil; hence the testing procedure itself somewhat replicates the behavior of a laterally loaded shaft, although to a much smaller scale. However, the PMT also has its flaws in transitional materials. The raw PMT

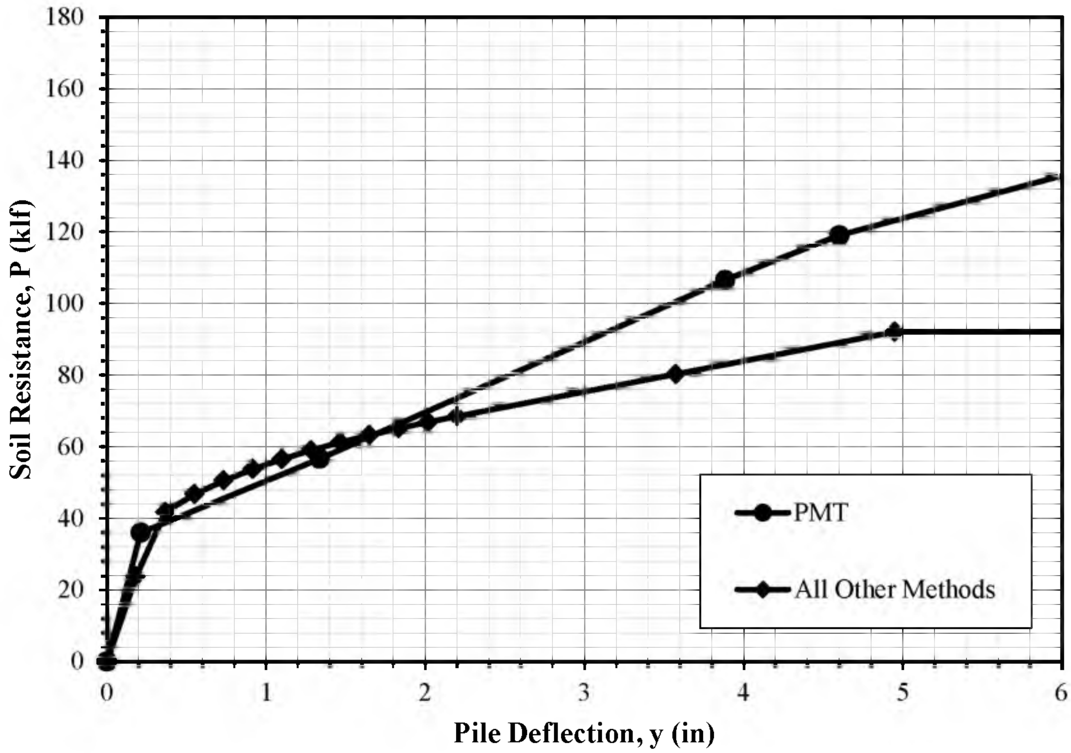

Fig. 8-11. *P-y* curves constructed from PMT data and various analytical methods for the depth of 5 ft

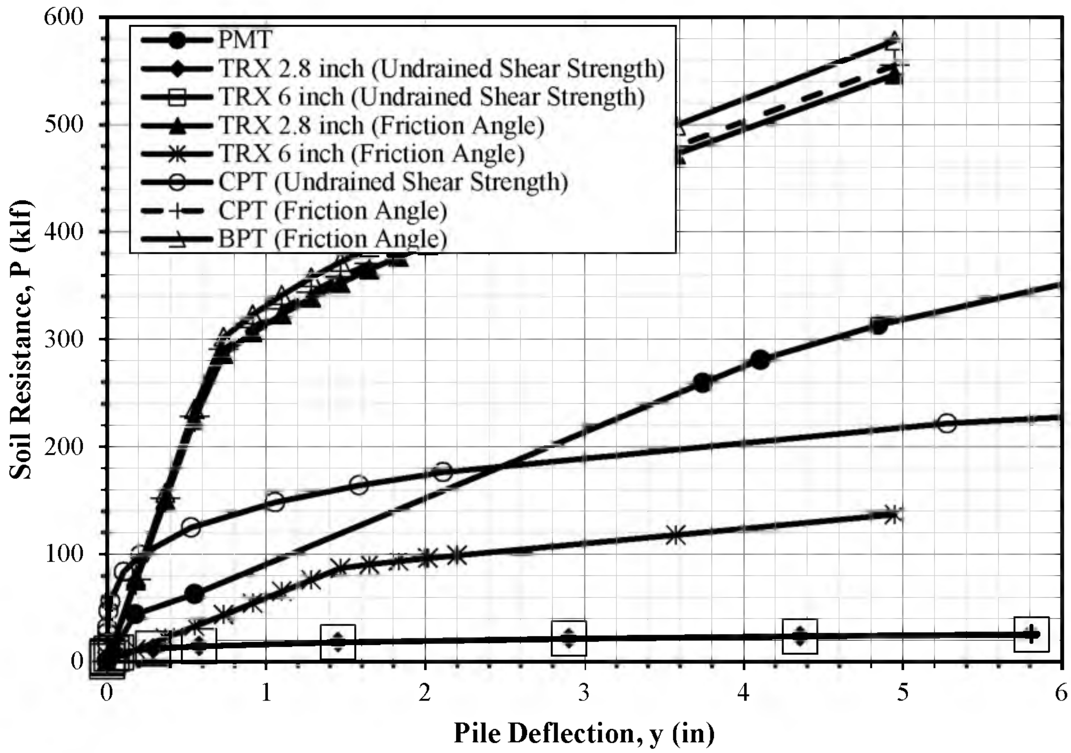

Fig. 8-12. *P-y* curves constructed from PMT data and various analytical methods for the depth of 14.5 ft

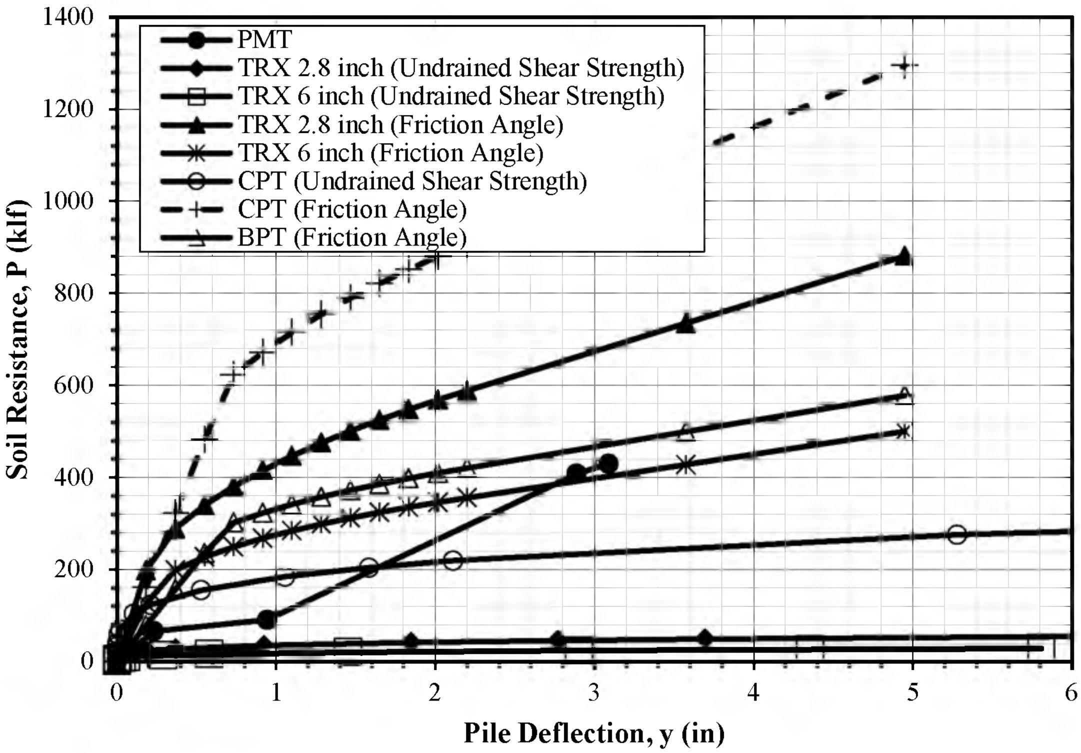

Fig. 8-13. *P-y* curves constructed from PMT data and various analytical methods for the depth of 29 ft

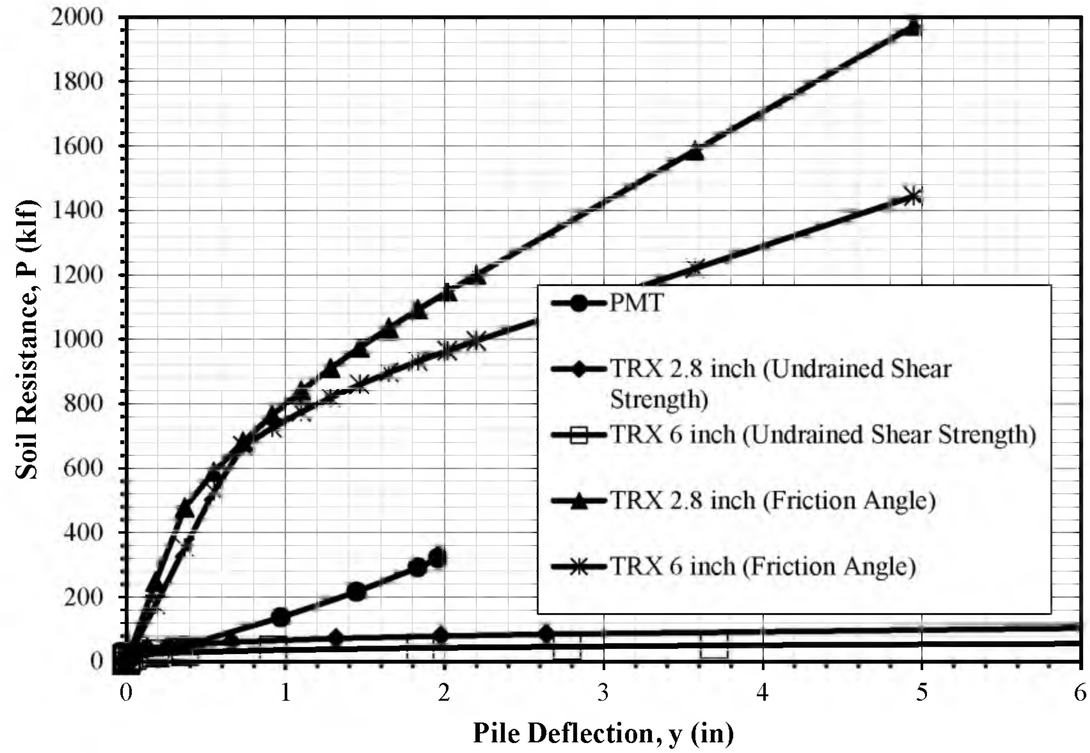

Fig. 8-14. *P-y* curves constructed from PMT data and various analytical methods for the depth of 42.8 ft

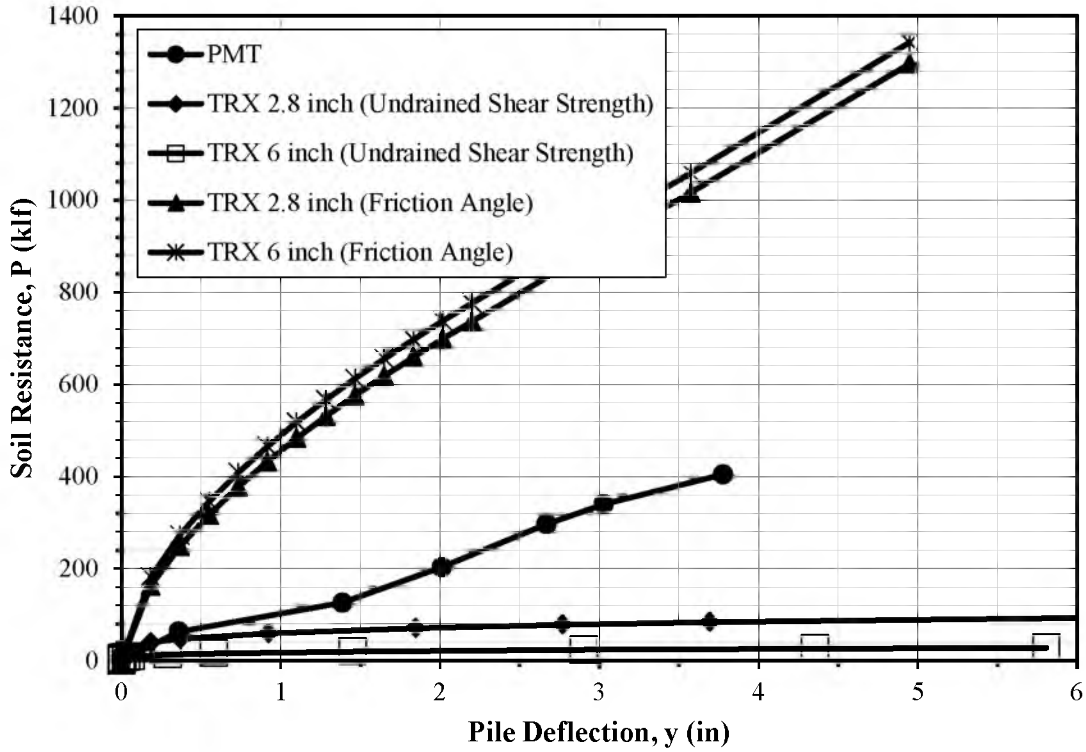

Fig. 8-15. *P-y* curves constructed from PMT data and various analytical methods for the depth of 57.5 ft

results are affected by gravel "seating" at which the initial stiffness doesn't build up because of the gravels filling up void space. Also, drilling through gravels and cobbles is not the best test condition for the pressuremeter, because the pressuremeter produces the best results when the boring is clean and smooth. The removal of the cobbles and gravels in the boring will create voids in the sidewall leaving a scarified surface. These effects can be seen in the raw data from the pressuremeter, and extrapolation is needed when reducing the data to produce *P-y* curves. As previously stated in Section 8.6, it is recommended that a full scale load test be performed at the site to determine which of the methods used in this study provide the best estimate of lateral deformation in the subsurface material due to the lateral loads on constructed shafts.

8.8 Summary

This chapter provided a summary of results for all the investigative methods used for the various analyses performed in *LPILE*. Details were given as to the criteria required for each analysis as well as the design results calculated from each analysis. Comparisons were made of the design results for each of the analytically based analyses performed against the PMT results, which were assumed to be the most accurate of all the methods used in this study. Also, a comparison of the *P-y* curves was presented in this chapter to help give explanations of the varying design results determined from the different methods used for analysis.

9 CONCLUSIONS

This study presents the details of a site specific investigation and drilled shaft foundation study for a site in Tremonton, Utah, which is along PacifiCorp's constructed 345 kV transmission line extending from Ogden, Utah to Downey, Idaho. This study used the data of a three part report previously submitted to PacifiCorp (Lawton et al., 2011), and its objective was to evaluate the shear strength and deformation characteristics of a granular, transitional soil for the proposed construction of laterally loaded drilled shafts.

The first task performed in this study was a detailed geological investigation at the site. This included a review of available geological mapping and information in the area to acquire information regarding the expected soils in the vicinity. In addition, geological hazards were preliminarily assessed including shallow groundwater, potential for landslides, and seismic hazards.

A geotechnical field investigation was carried out at the site and included field density tests, standard penetration tests, pressuremeter tests, Becker penetration tests, and cone penetration tests. Soil sampling was completed by acquiring bulk samples obtained during the vibratory sonic drilling performed at the site. The subsurface materials encountered at the site consisted of mostly granular, transitional soils with gravels and larger cobbles. A geotechnical laboratory investigation was completed for the site and included standard tests such as water content determination, particle size analysis, and

Atterberg limit testing. In addition, 2.8 in. diameter and 6 in. diameter triaxial compression tests were performed at depths corresponding to the pressuremeter testing depths for comparative purposes. The tests were performed in CIDC initially, but then it was determined to used CIUC conditions after reviewing some of the results and the degrees of saturation of the in situ soils.

A comparison was made on the results of the small and larger size diameter triaxial compression tests. Resulting peak internal friction angles and the undrained shear strengths determined from the tests were compared. This comparison showed, for the most part, that significant reductions in the shear strength properties were obtained from the large (i.e., 6 in.) diameter tests compared to the smaller (i.e., 2.8 in.) diameter tests. The results of peak internal friction angles indicated reductions ranging from 36% to 68% for the large tests when compared to the smaller diameter tests. Similarily, the undrained shear strengths indicated reductions ranging from 61% to 73%.

It should be noted that the triaxial compression test results are not considered high quality becuase the samples were highly disturbed, destroying any natural cementation and fabric encountered during the in-situ condition. In addition, the samples were reconstituted and were also scalped per ASTM standards, thus removing a percentage of the larger particles comprised in the in situ soils. Because of these considerations, it is highly recommended that several additional triaxial compression tests be performed to gain a more accurate representation of the results expected from similar tests on similar granular transitional soils. In addition, it is recommended that such tests be completed with strain gauges in the middle of the sample to reduce the effects of “end restraint.” The results were also compared to a previous study by Chew and Bharati (2011), which reported similiar reductions in undrained shear strength results, ranging up to 70% for larger diameter tests, when compared to the results determined from smaller diameter tests.

The results of the field and laboratory investigations were used to determine shear strength and deformation properties of the subsurface materials encountered at the site. These properties were applied in the analyses completed in *LPILE* to design the laterally loaded shafts in accordance with the design criteria required in PacifiCorp's design standard TA-071. All analyses were completed using a shaft diameter of 11 ft, which is the minimum required by the corresponding diameter of the structure supported by the drilled shaft. A total of eight analyses were performed using the data determined from the various testing methods. The analyses were based on the following:

- *P-y* curves determined from the pressuremeter data.
- Undrained shear strengths of the small and large diameter triaxial compression tests.
- Peak internal friction angles derived from the small and large diameter triaxial tests.
- Peak internal friction angles derived from the Becker penetration tests.
- The undrained shearing strengths determined from the cone penetration tests.
- The peak internal friction angles determined from the cone penetration tests.

The analyses performed utilizing the data from the pressuremeter tests were assumed to be the most reliable because the test method is performed in-situ and reasonably replicates the load path expected for a laterally loaded shaft. The results of the pressuremeter based analysis required a shaft length of 40 ft. The resulting shaft lengths determined from all other methods ranged from 28 ft to 95 ft, with the shorter, less conservative results derived from analyses based on peak internal friction angles, and the longer more conservative results derived from methods based on estimates of undrained shear strength.

Due to the wide variation in estimates of the required shaft lengths calculated for the various investigative methods, comparisons were also made of the *P-y* curves derived for each method. The analytical methods used by *LPILE*, which are based on the findings of Welch and Reese (1972) and Reese (1974), for "Stiff Clay w/o Free Water" and "Sand (Reese)", respectively, were used to develop the *P-y* curve comparative plots. This comparison showed that *P-y* curves based on the pressuremeter were located in the middle range values developed from other investigative methods. In addition, curves based on peak internal friction angle were much stiffer than median values, and curves derived from estimates of undrained shear strength were less stiff than median values.

Because of the significant variation in *P-y* curves and estimates of required shafts lengths obtained from the various *LPILE* analyses, it is recommended that full scale load tests be completed at the Tremonton site to determine the actual behavior of the drilled shaft to lateral loading. This information would be invaluable for validating the techniques employed herein, would provide investigative and design guidance to practicing geotechnical and structural engineers associated with design of laterally loaded shafts in transitional materials.

APPENDIX A

GRAIN SIZE DISTRIBUTION CURVES

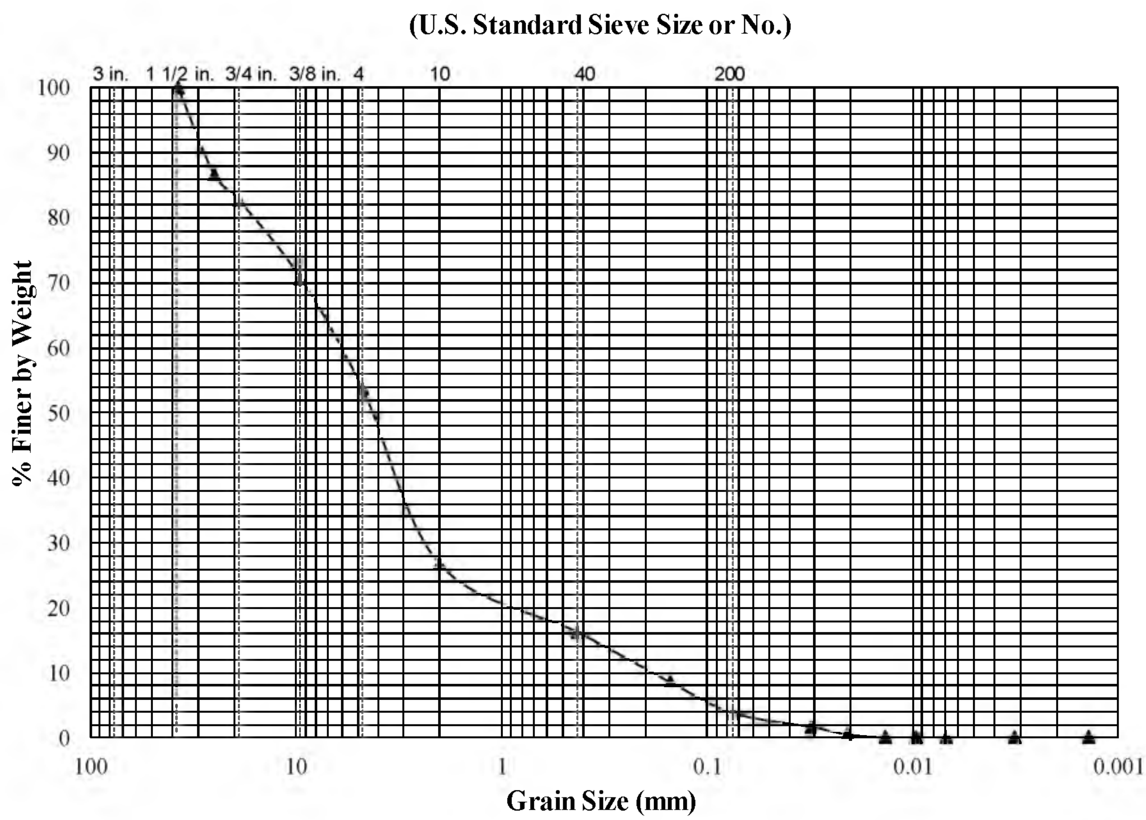

Fig. A-1. GSD curve for sample taken from 0 to 2.5 ft

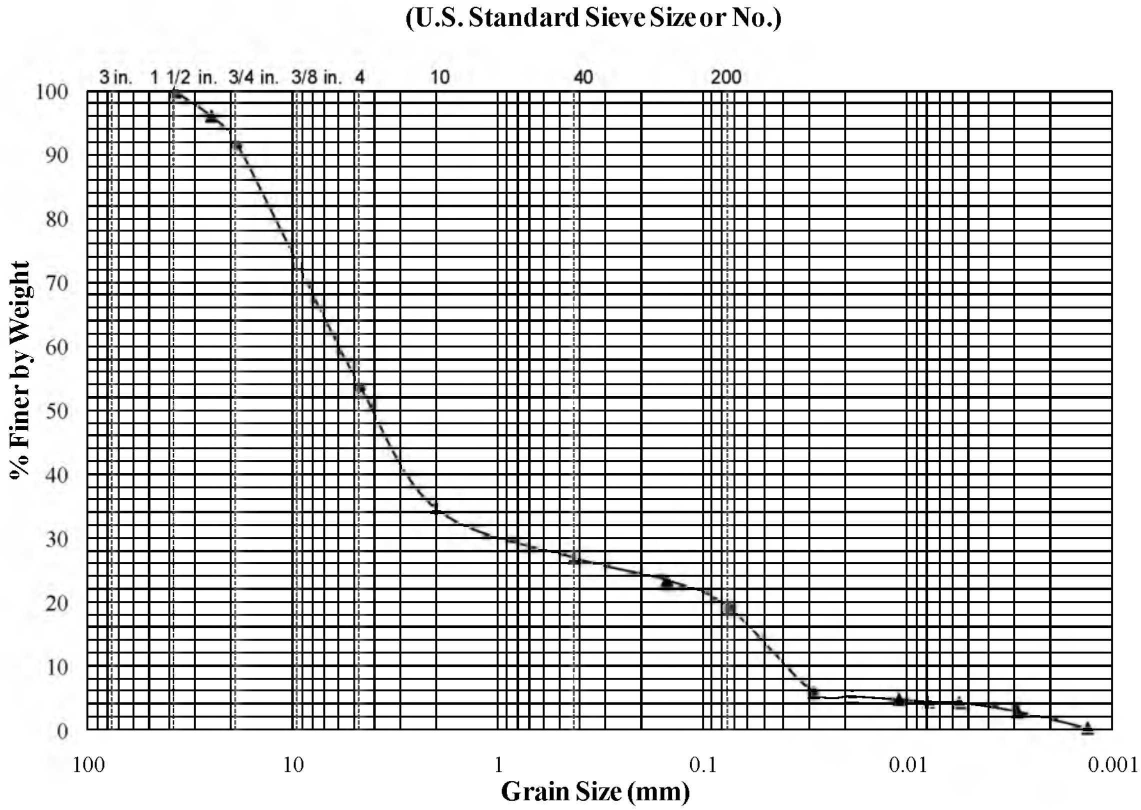

Fig. A-2. GSD curve from 2.5 to 5.0 ft depth

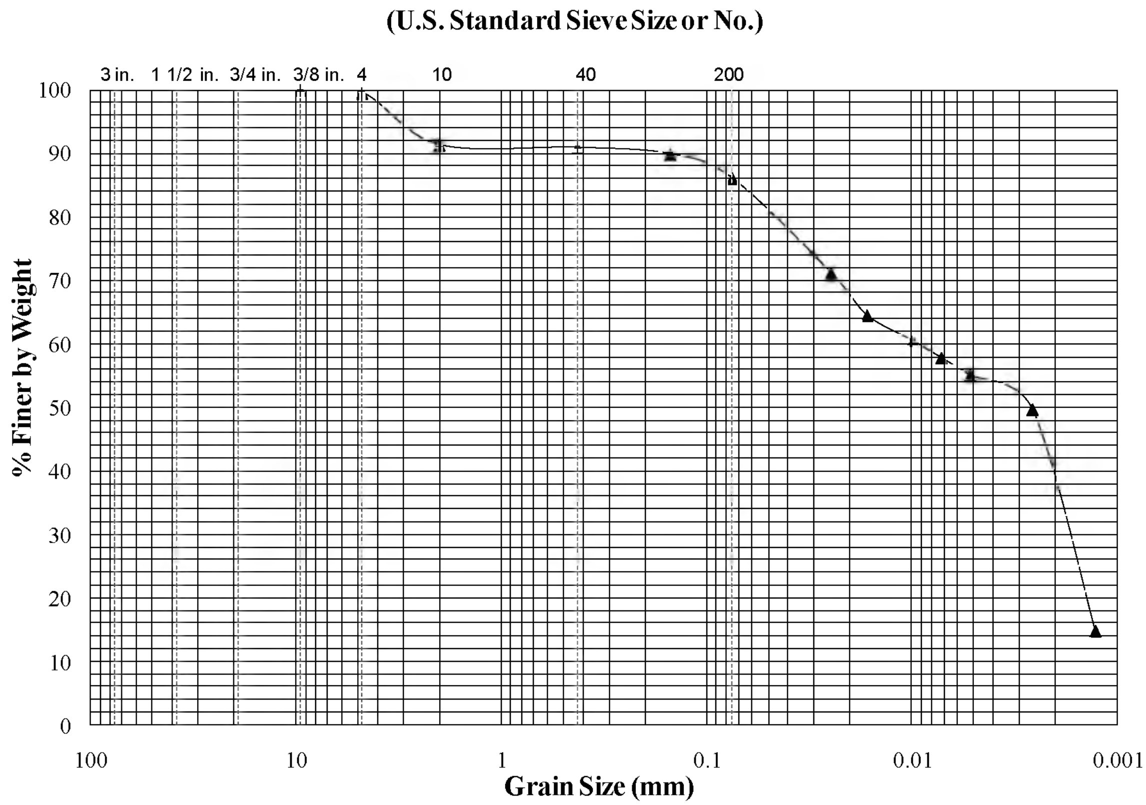

Fig. A-3. GSD curve from 5.0 to 7.5 ft depth

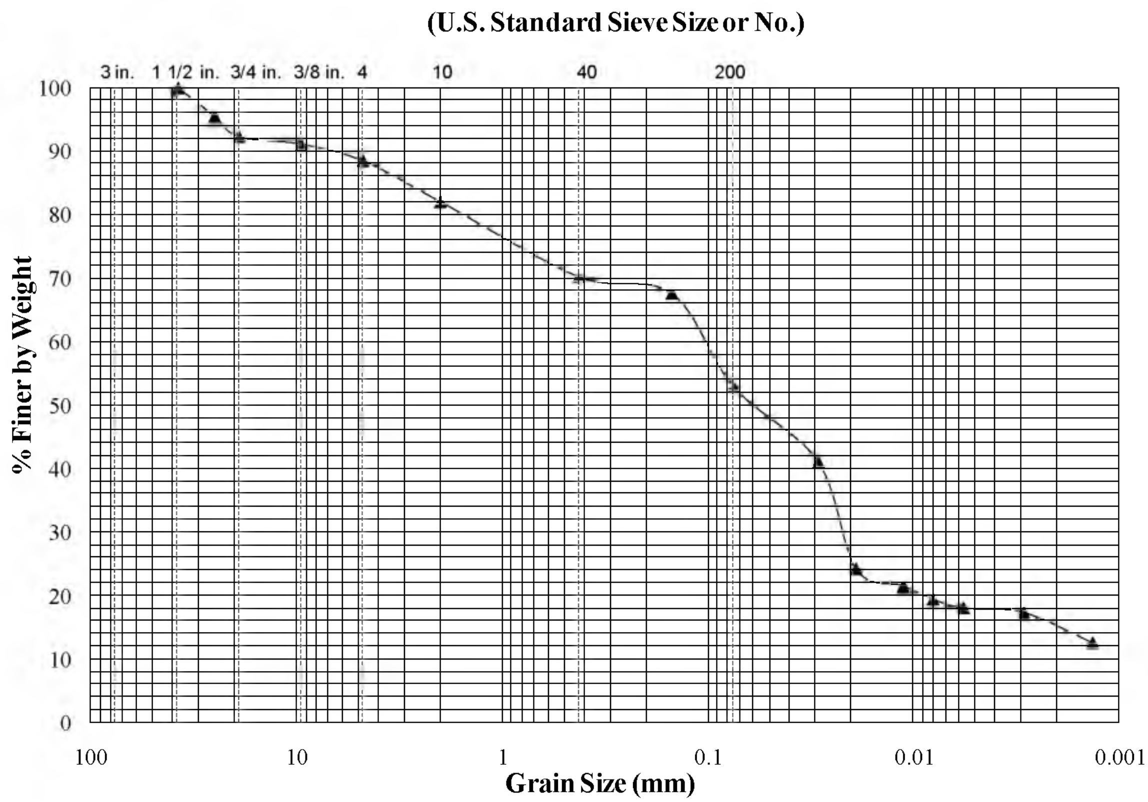

Fig. A-4. GSD curve from 7.5 to 10.0 ft depth

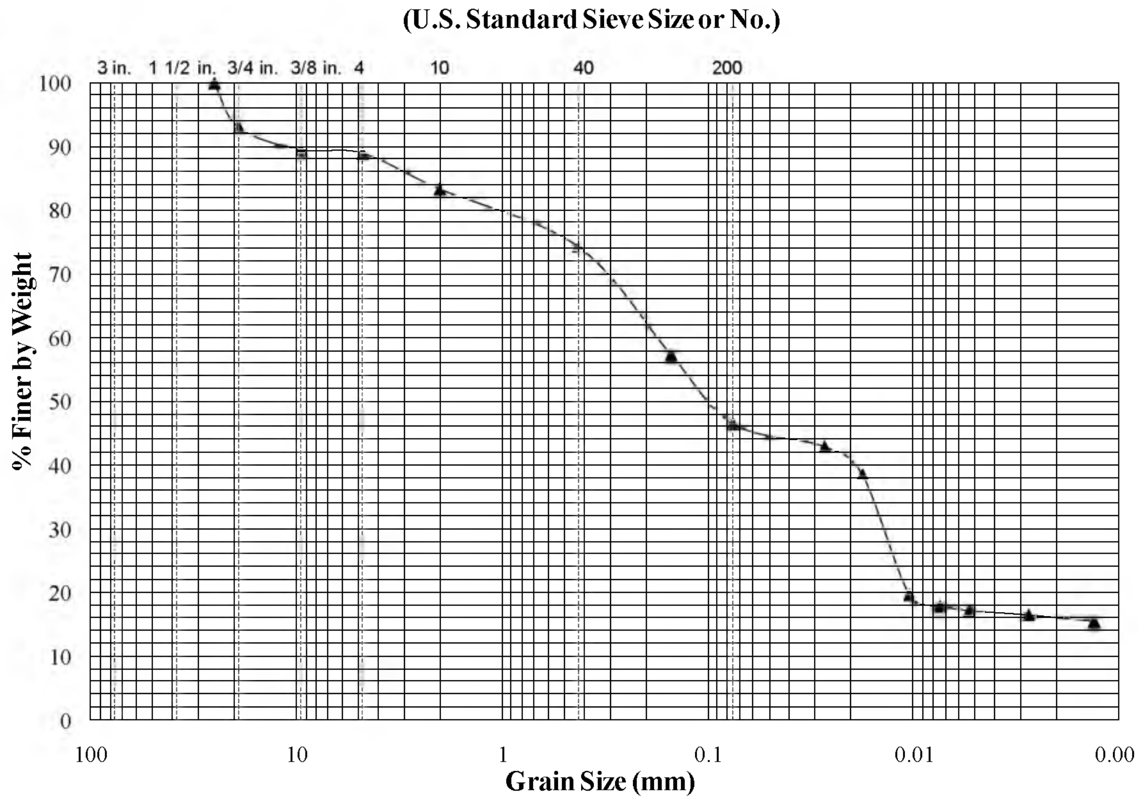

Fig. A-5. GSD curve from 10.0 to 12.5 ft depth

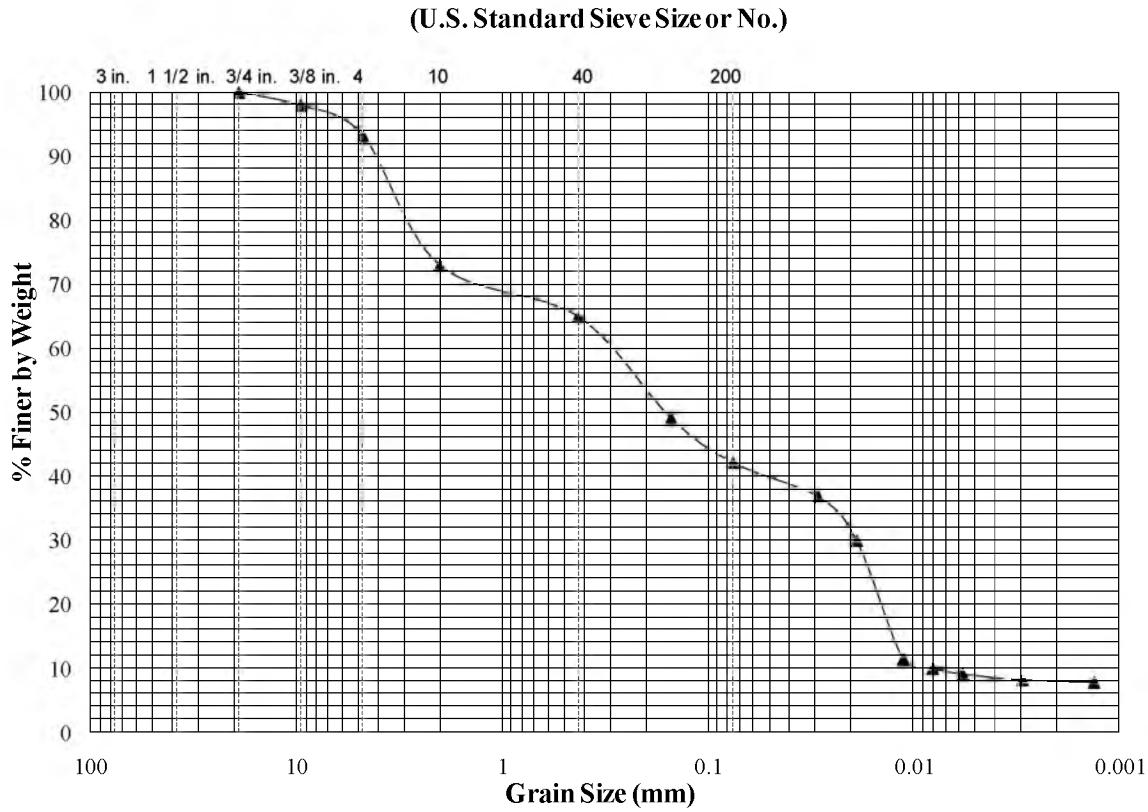

Fig. A-6. GSD curve from 12.5 to 15.0 ft depth

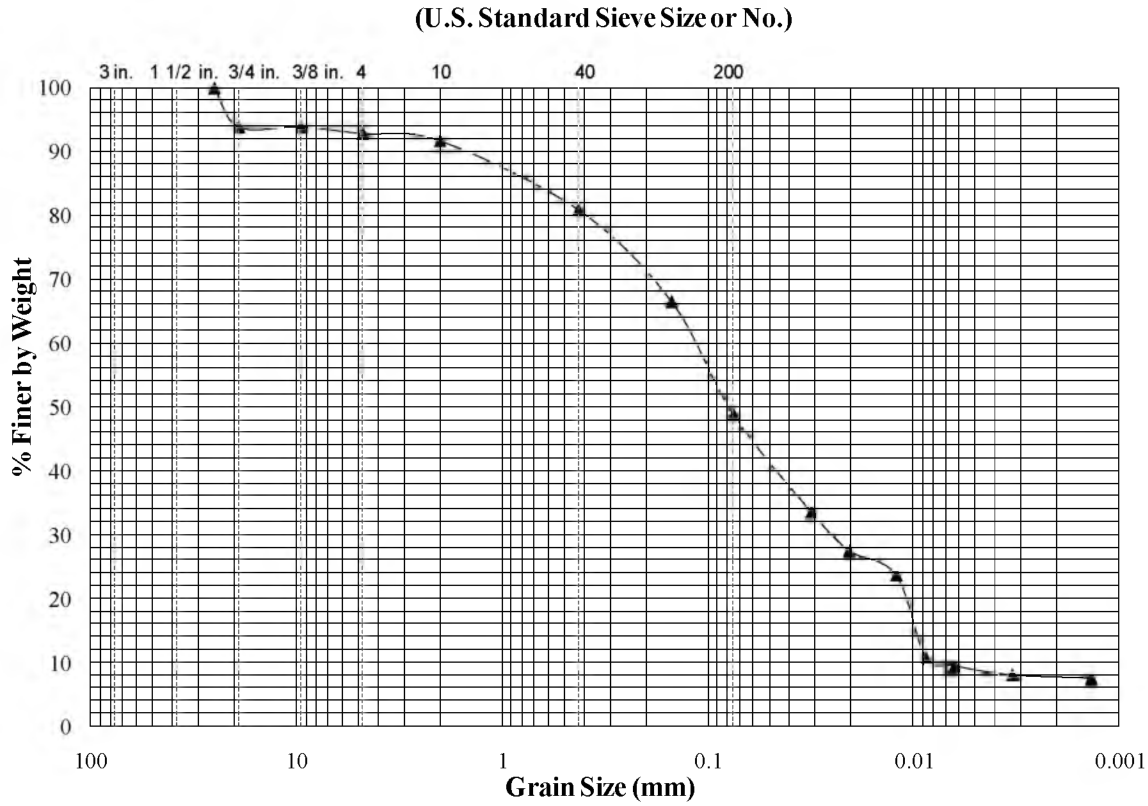

Fig. A-7. GSD curve from 15.0 to 17.5 ft depth

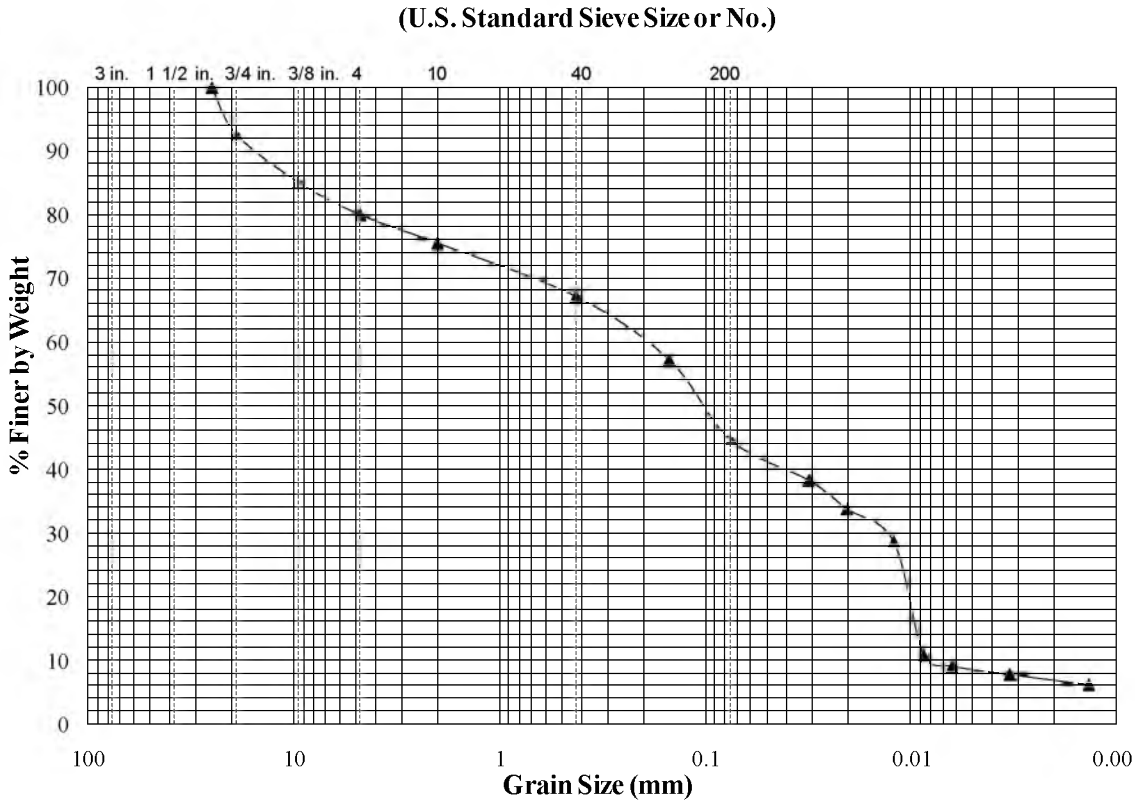

Fig. A-8. GSD curve from 17.5 to 20.0 ft depth

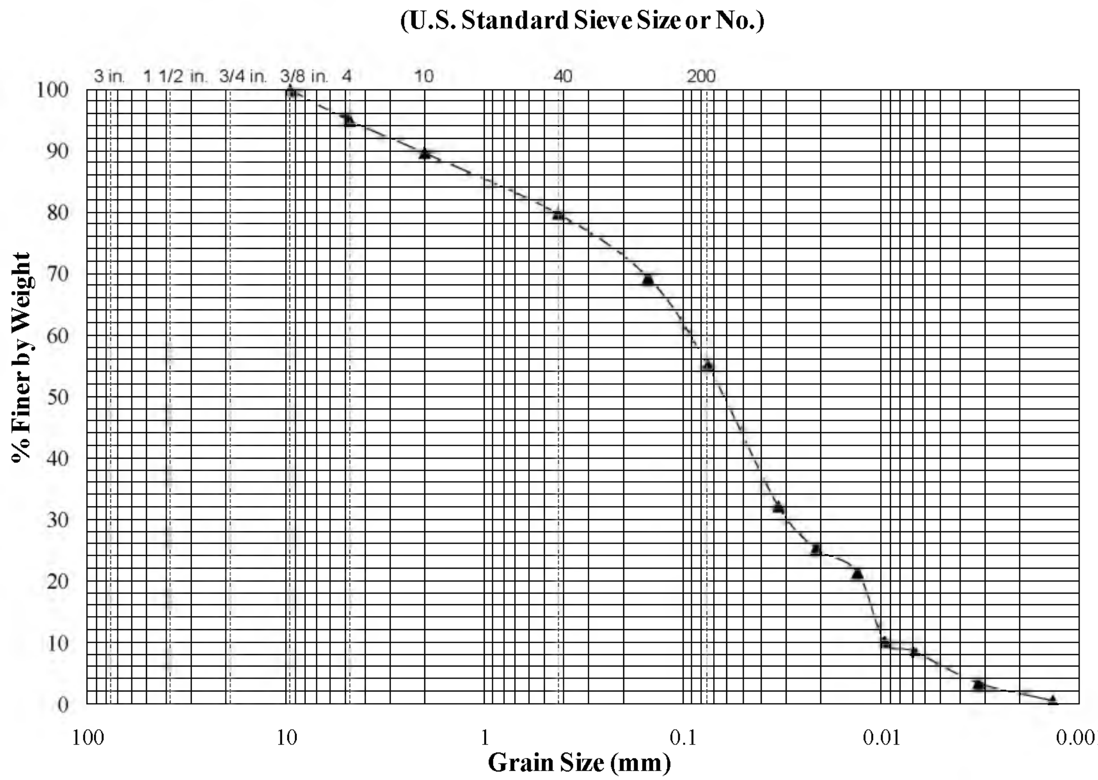

Fig. A-9. GSD curve from 20.0 to 22.5 ft depth

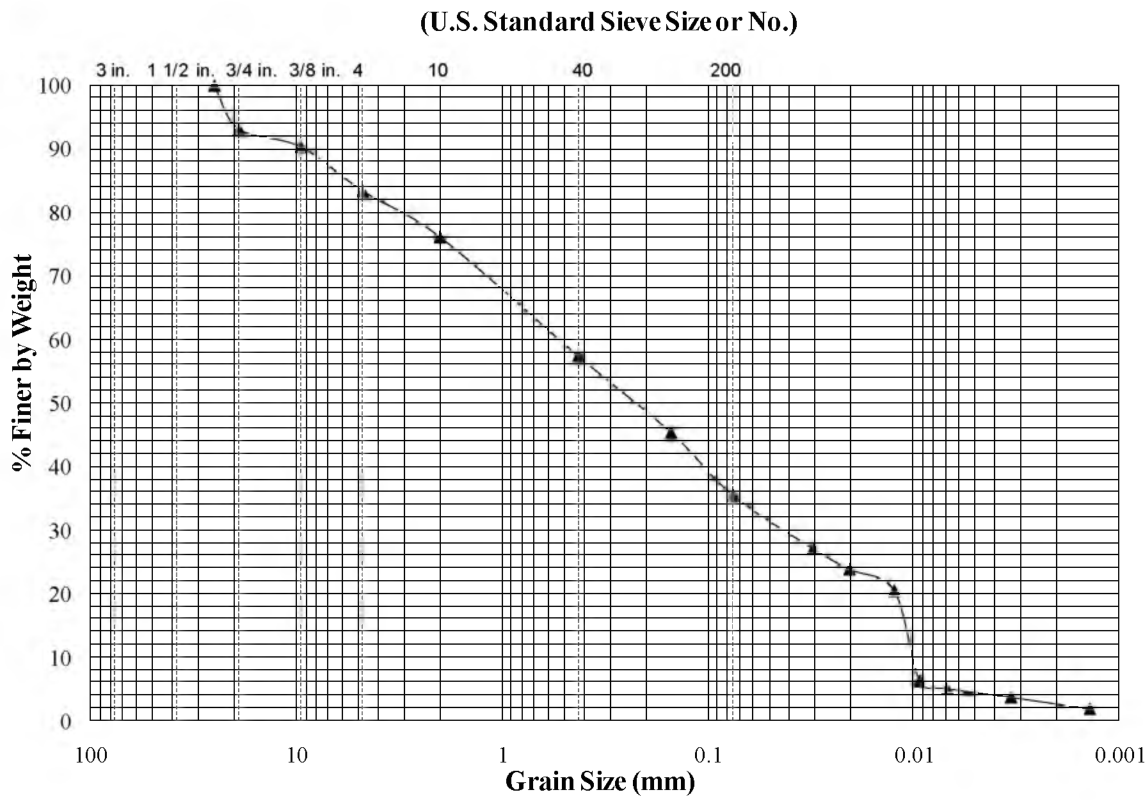

Fig. A-10. GSD curve from 22.5 to 25.0 ft depth

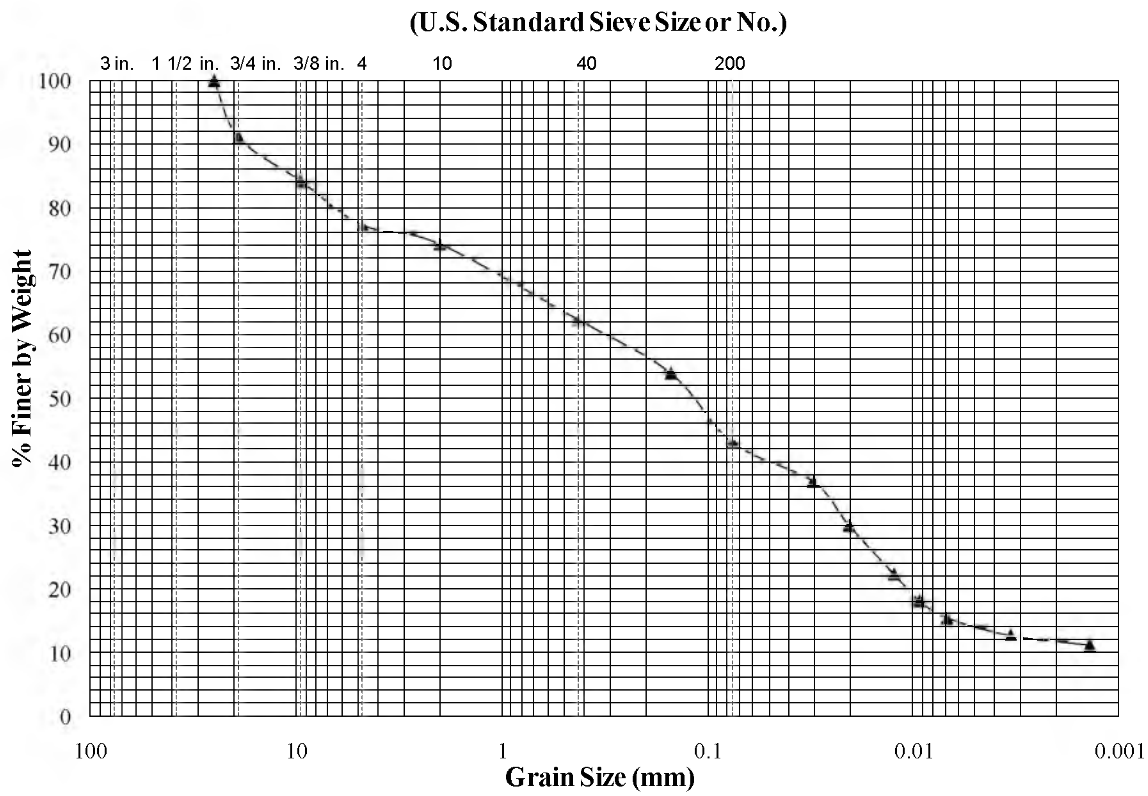

Fig. A-11. GSD curve from 25.0 to 27.5 ft depth

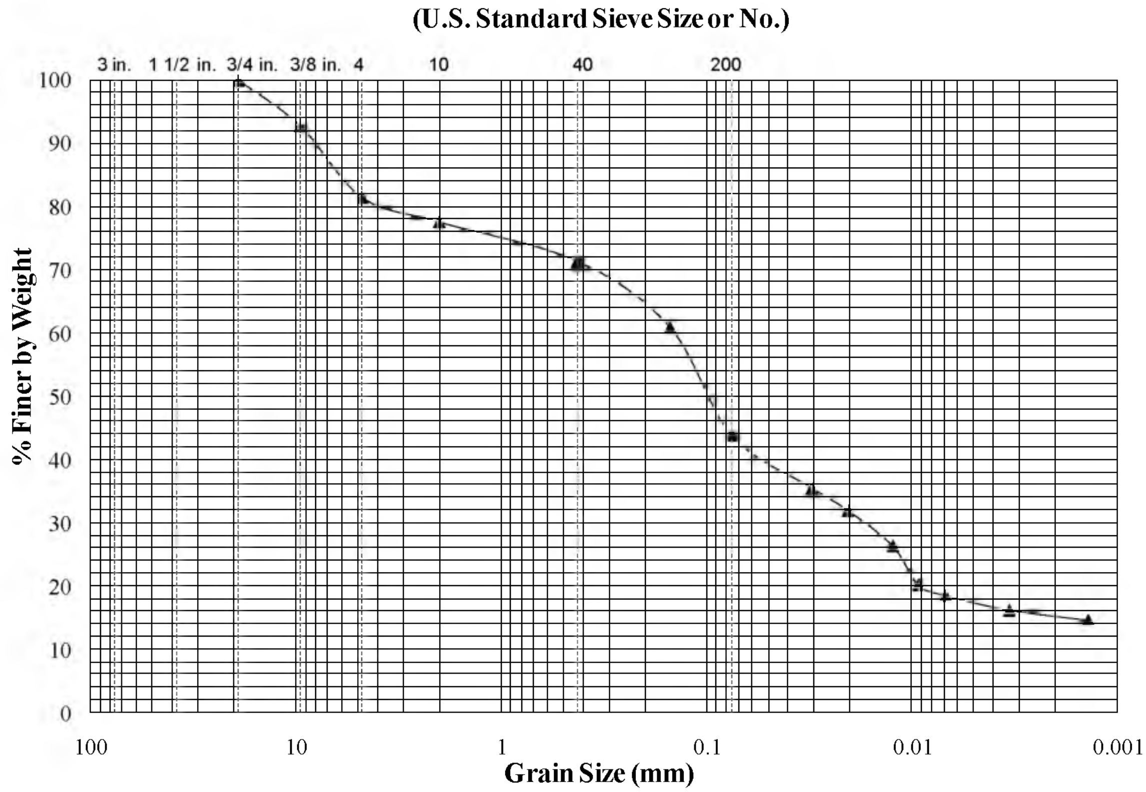

Fig. A-12. GSD curve from 27.5 to 30.0 ft depth

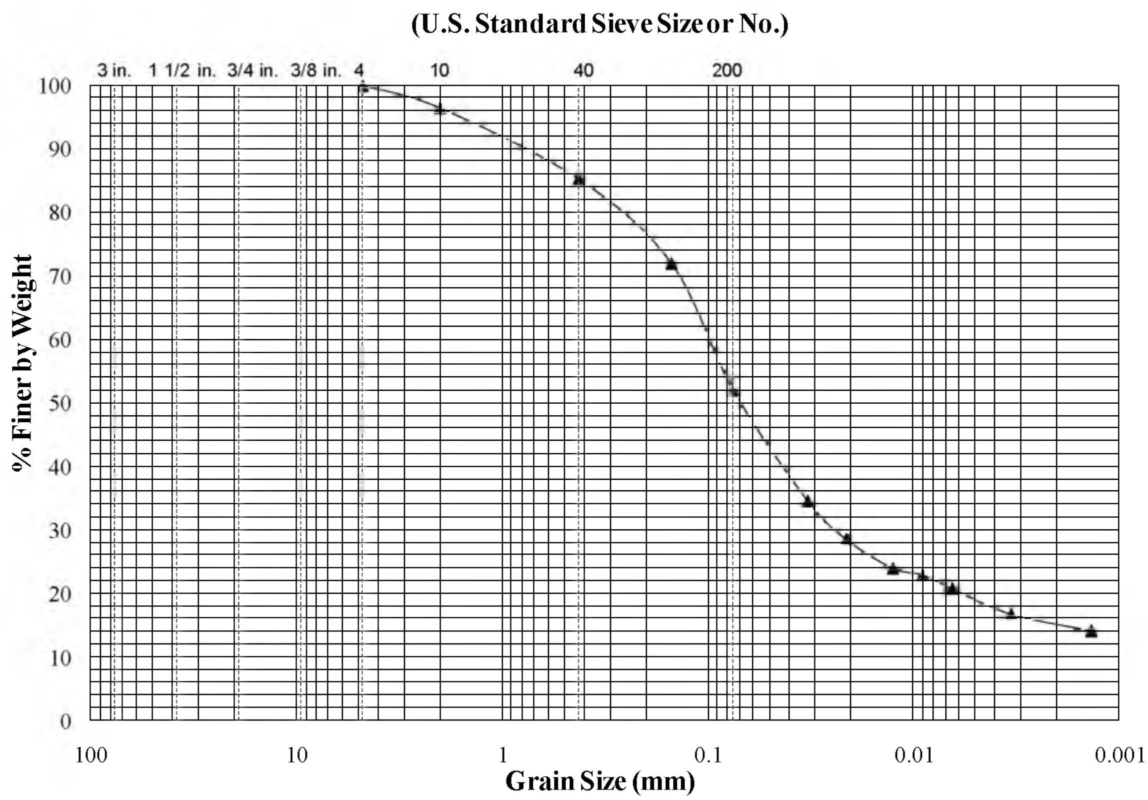

Fig. A-13. GSD curve from 30.0 to 32.5 ft depth

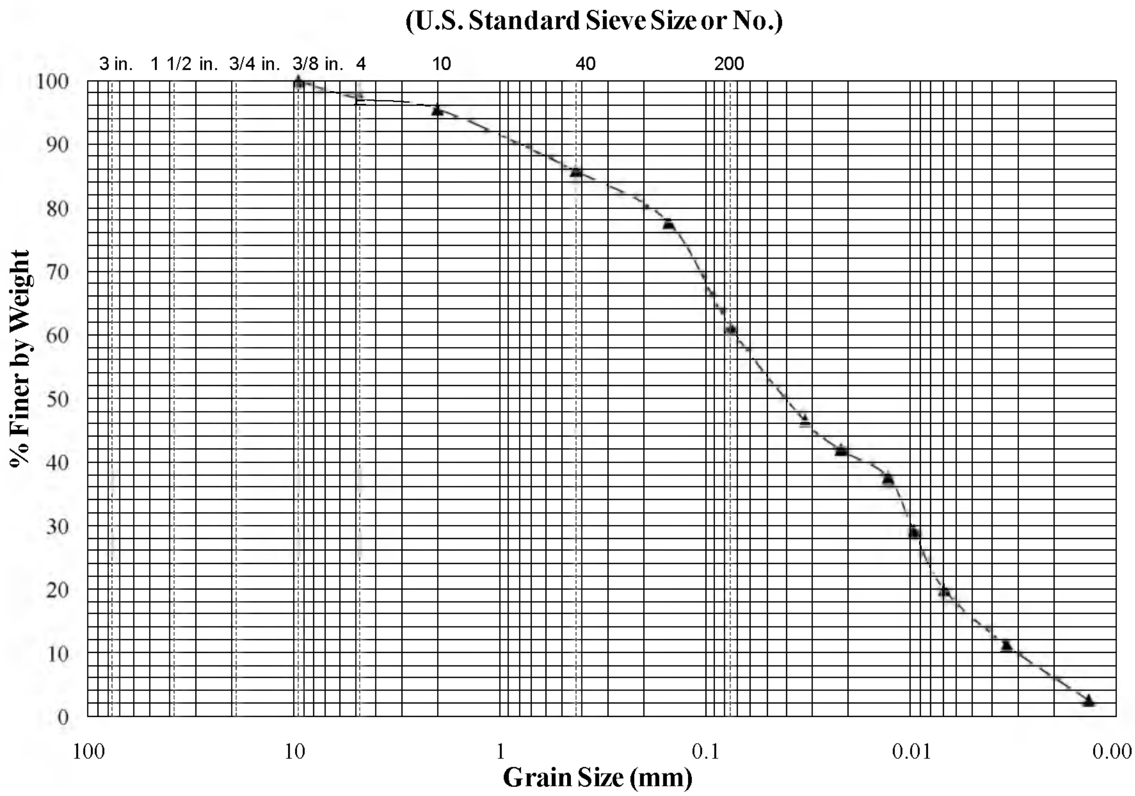

Fig. A-14. GSD curve from 32.5 to 35.0 ft depth

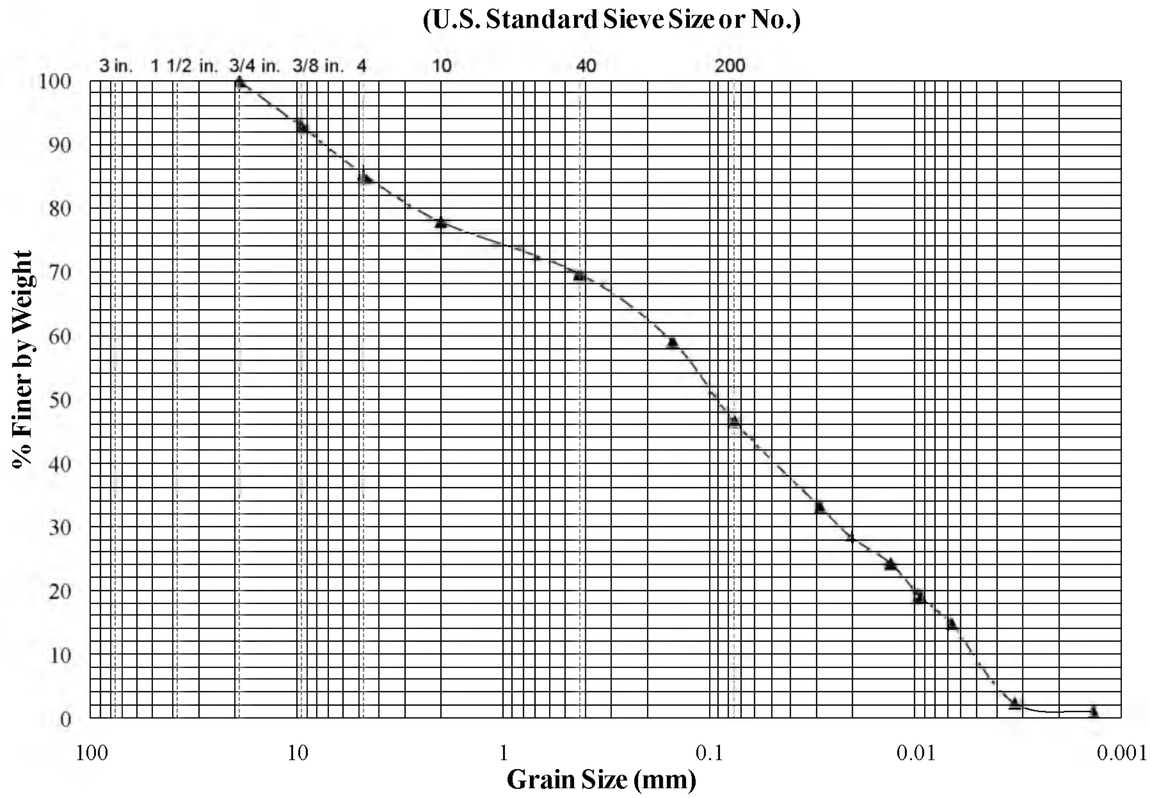

Fig. A-15. GSD curve from 35.0 to 37.5 ft depth

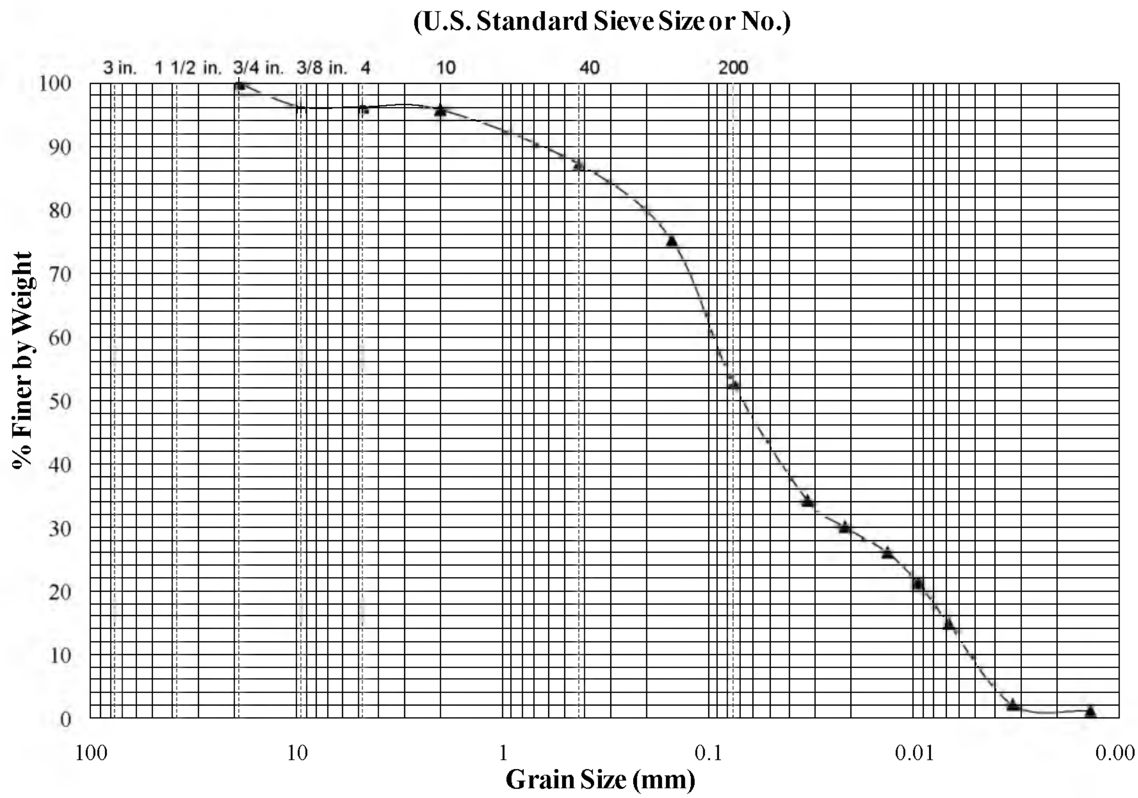

Fig. A-16. GSD curve from 37.5 to 40.0 ft depth

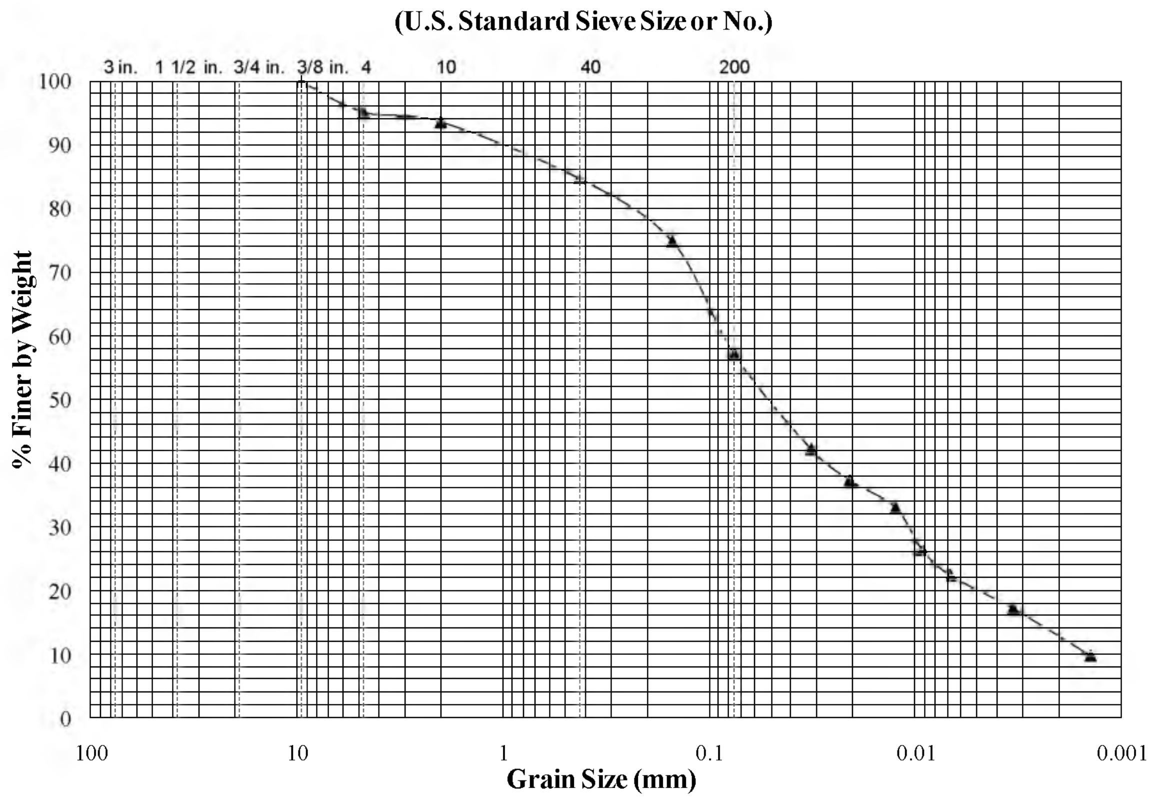

Fig. A-17. GSD curve from 40.0 to 42.5 ft depth

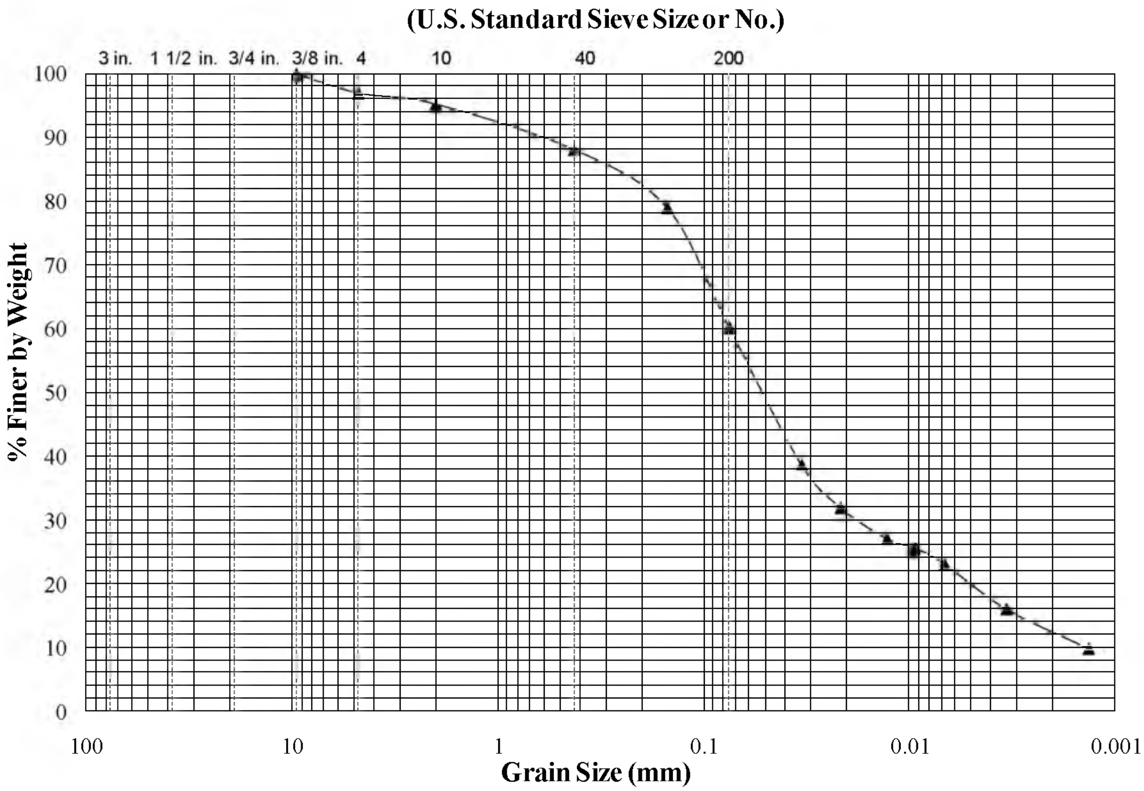

Fig. A-18. GSD curve from 42.5 to 45.0 ft depth

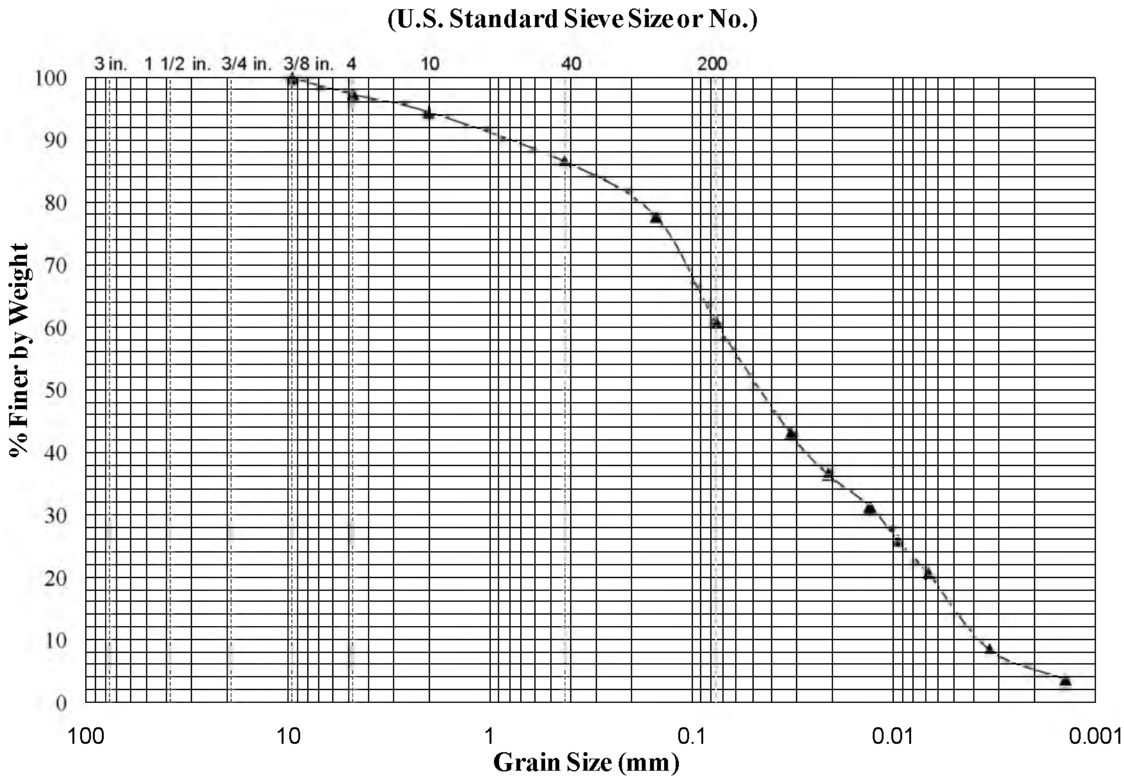

Fig. A-19. GSD curve from 45.0 to 47.5 ft depth

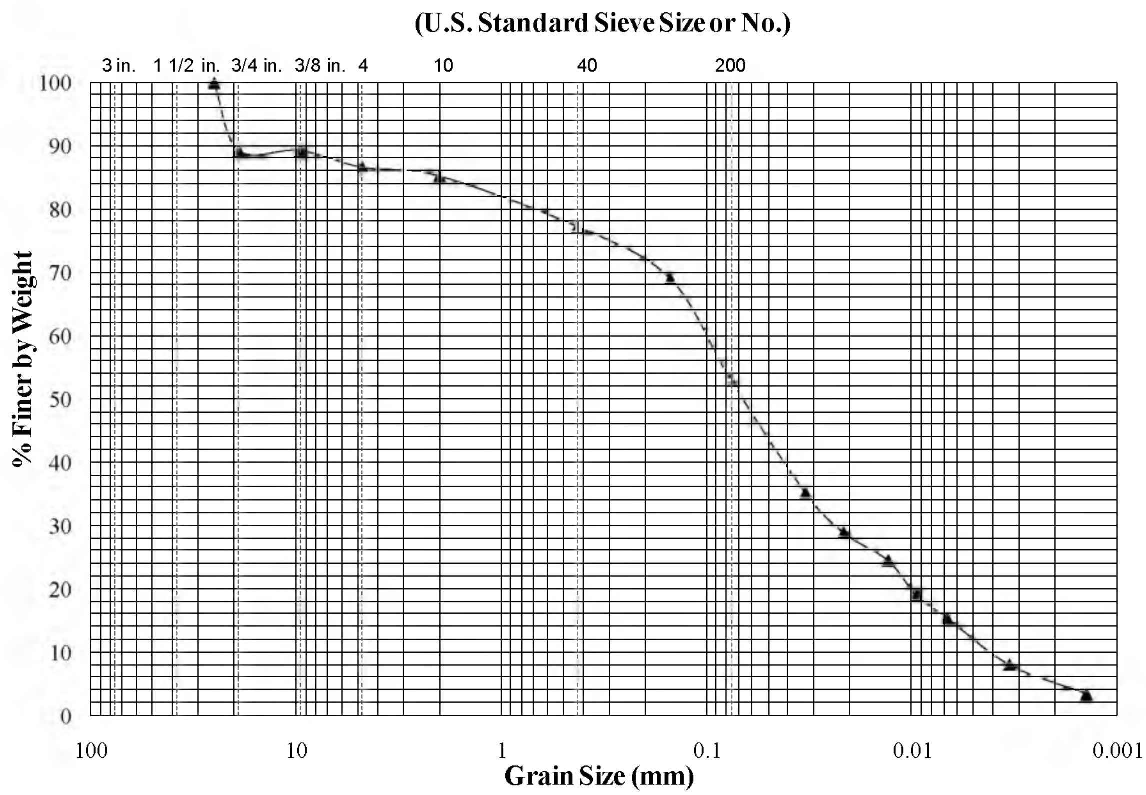

Fig. A-20. GSD curve from 47.5 to 50.0 ft depth

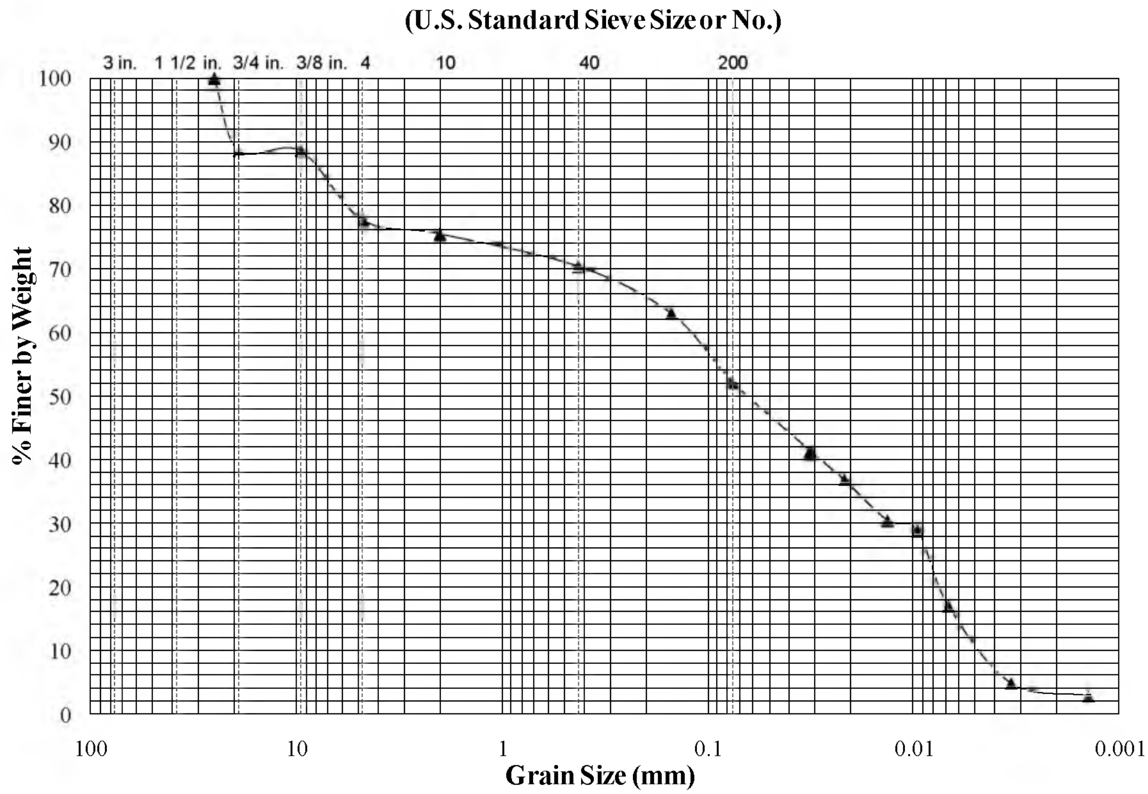

Fig. A-21. GSD curve from 50.0 to 52.5 ft depth

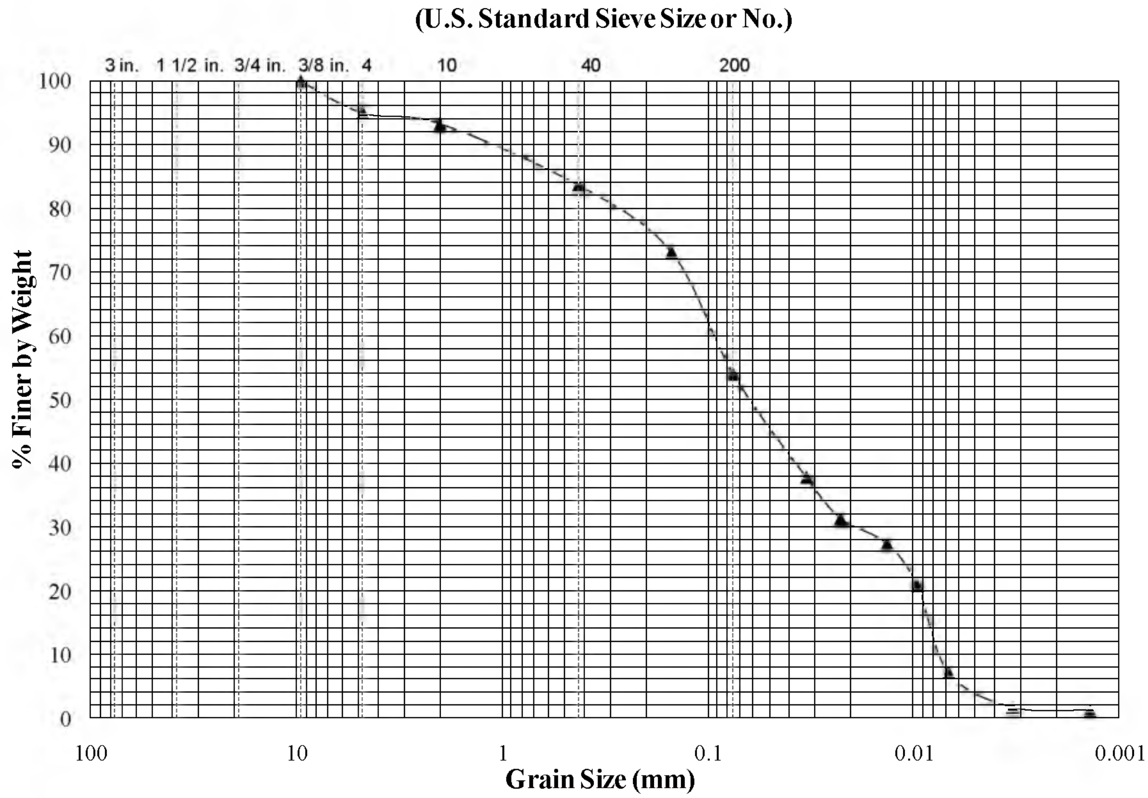

Fig. A-22. GSD curve from 52.5 to 55.0 ft depth

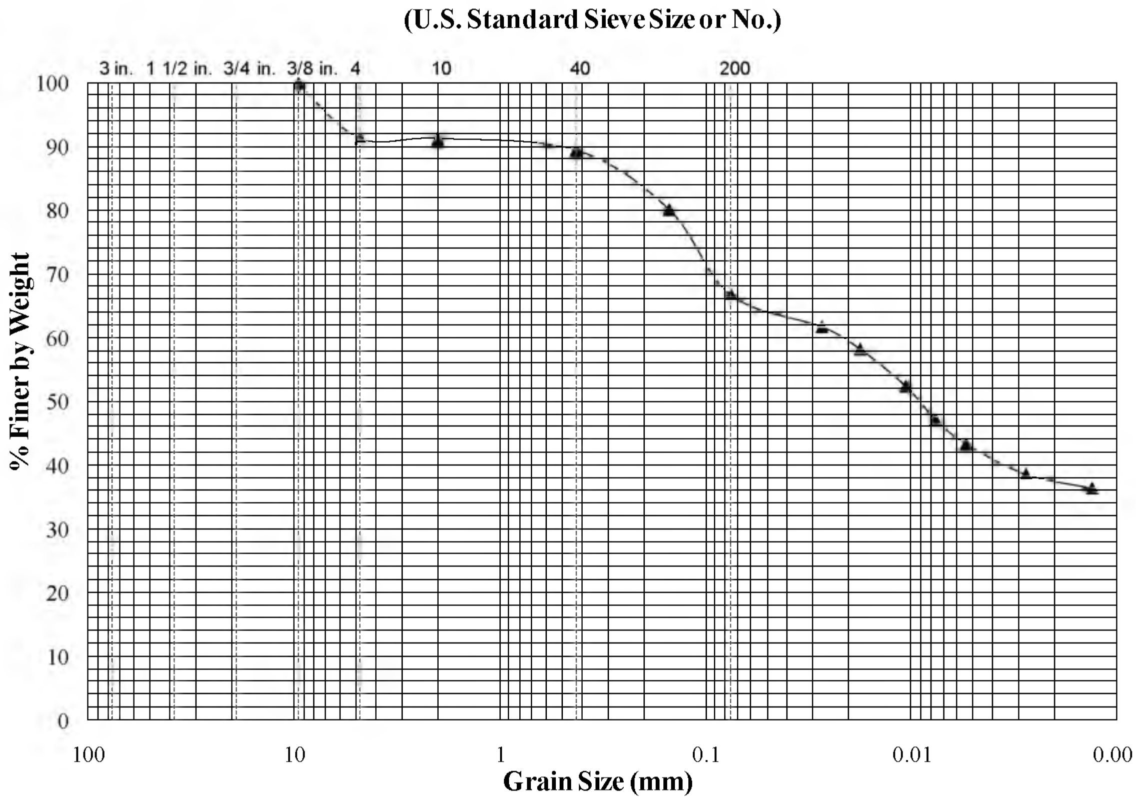

Fig. A-23. GSD curve from 55.0 to 57.5 ft depth

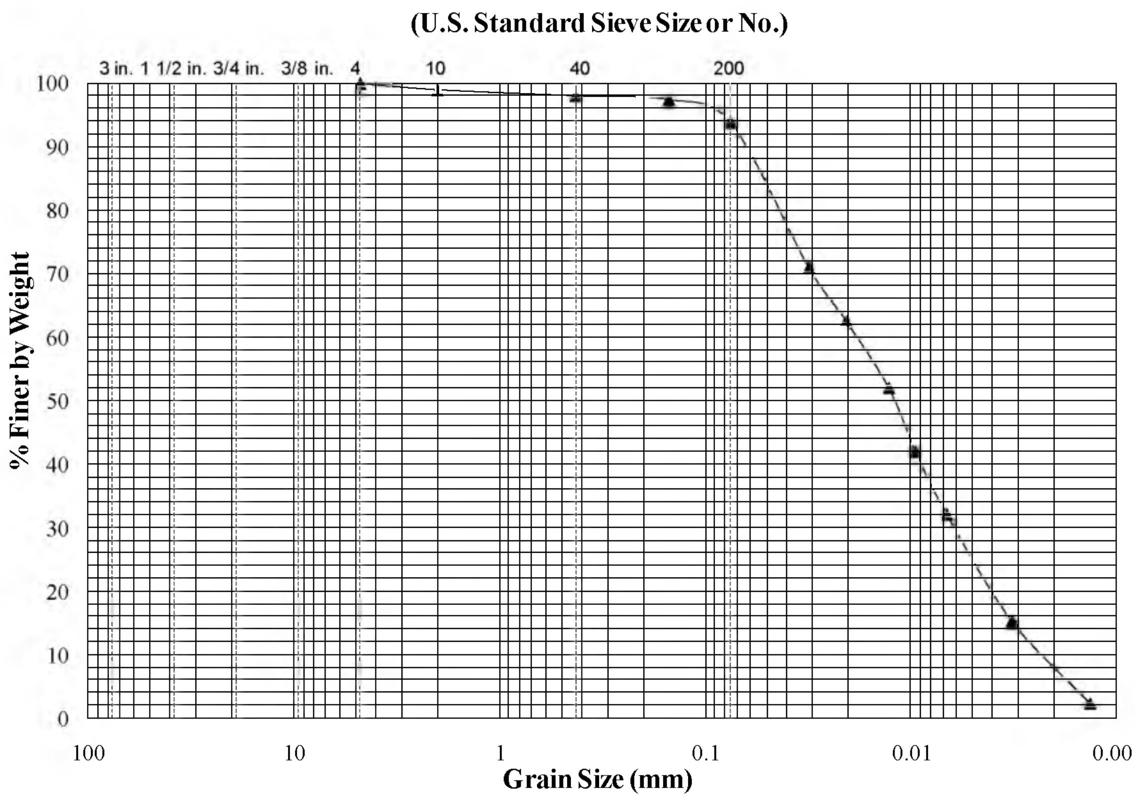

Fig. A-24. GSD curve from 57.5 to 60.0 ft depth

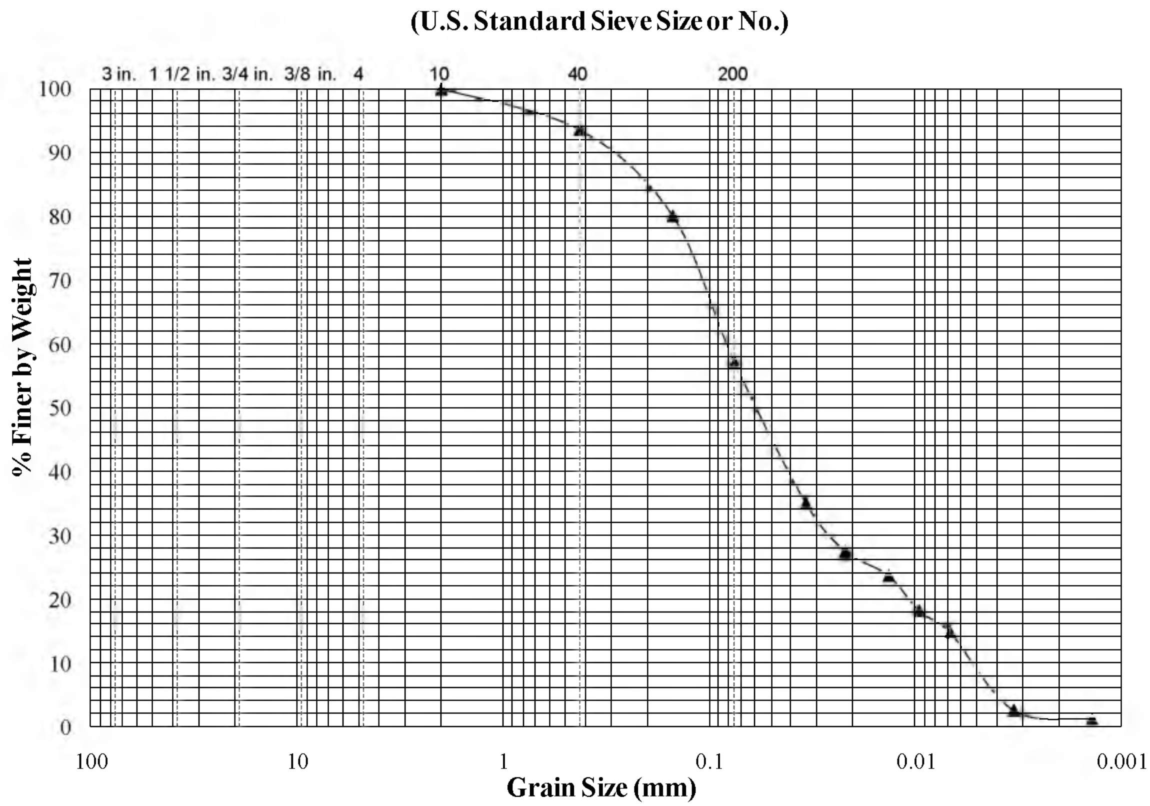

Fig. A-25. GSD curve from 60.0 to 62.5 ft depth

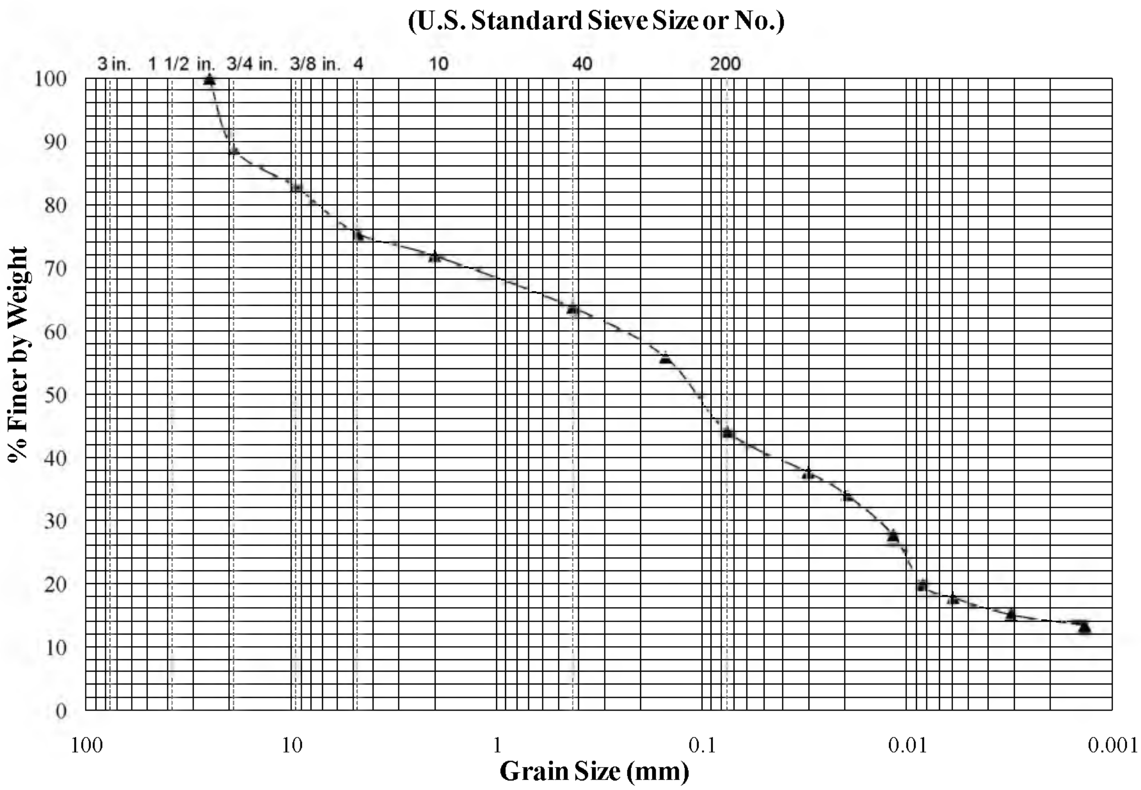

Fig. A-26. GSD curve from 62.5 to 65.0 ft depth

APPENDIX B

LPILE OUTPUT

B.1 Using P-y Curves from the PMT (Service)

```
==================================================================================

LPILE Plus for Windows, Version 5.0 (5.0.47)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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==================================================================================

This program is licensed to:

Zach McClellan
University Of Utah

----------------------------------------------------------------------------------
Files Used for Analysis
----------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled SHaft Analysis Using PMT Data Adjusted.lpd
Name of output file:         Drilled SHaft Analysis Using PMT Data Adjusted.lpo
Name of plot output file:    Drilled SHaft Analysis Using PMT Data Adjusted.lpp
Name of runtime file:        Drilled SHaft Analysis Using PMT Data Adjusted.lpr


--------------------------------------------------------------------------------
Time and Date of Analysis
--------------------------------------------------------------------------------

Date:  October 11, 2012     Time:  13:40:42


--------------------------------------------------------------------------------
Problem Title
--------------------------------------------------------------------------------

Drilled Shaft Analysis Using PMT Data


--------------------------------------------------------------------------------
Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- User-specified p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs.
pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =         100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1
```

Pile Structural Properties and Geometry

Pile Length = 480.00 in

Depth of ground surface below top of pile = 12.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point	Point	Pile	Moment of	Pile	Modulus of
No.	Depth	Diameter	Inertia	Area	Elasticity
in	in	in**4	Sq.in	lbs/Sq.in	
1	0.0000	132.00000	14902723.	13685.0000	3604997.
2	480.0000	132.00000	14902723.	13685.0000	3604997.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of moment of inertia and modulus of are not used for any computations other than total stress due to combined axial loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 11 layers

Layer 1 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 12.000 in
Distance from top of pile to bottom of layer = 72.000 in

Layer 2 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 72.000 in
Distance from top of pile to bottom of layer = 132.000 in

Layer 3 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 186.000 in

Layer 4 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 186.000 in
Distance from top of pile to bottom of layer = 282.000 in

Layer 5 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 282.000 in
Distance from top of pile to bottom of layer = 360.000 in

Layer 6 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 360.000 in
Distance from top of pile to bottom of layer = 432.000 in

Layer 7 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 432.000 in
Distance from top of pile to bottom of layer = 525.000 in

Layer 8 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 525.000 in
Distance from top of pile to bottom of layer = 672.000 in

Layer 9 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 672.000 in
Distance from top of pile to bottom of layer = 702.000 in

Layer 10 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 702.000 in
Distance from top of pile to bottom of layer = 732.000 in

Layer 11 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 732.000 in
Distance from top of pile to bottom of layer = 792.000 in

(Depth of lowest layer extends 312.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 22 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06800
6	186.00	0.06800
7	186.00	0.06800
8	282.00	0.06800
9	282.00	0.07200
10	360.00	0.07200
11	360.00	0.06400
12	432.00	0.06400
13	432.00	0.07400
14	525.00	0.07400
15	525.00	0.07100
16	672.00	0.07100
17	672.00	0.07200
18	702.00	0.07200
19	702.00	0.07200
20	732.00	0.07200
21	732.00	0.07100
22	792.00	0.07100

Shear Strength of Soils

Shear strength parameters with depth defined using 0 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.001	1.0000	1.0000
4	792.000	1.0000	1.0000

User-specified p-y Curves

User-specified p-y curves defined using 22 curves.

User-specified curve number 1 at depth = 12.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000

2	0.2100	1390.000
3	1.3400	2200.000
4	3.8800	4130.000
5	4.6000	4620.000
6	6.7500	5610.000
7	9.5800	6390.000

User-specified curve number 2 at depth = 72.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.2100	3000.000
3	1.3400	4720.000
4	3.8800	8880.000
5	4.6000	9920.000
6	6.7500	12100.000
7	9.5800	13700.000

User-specified curve number 3 at depth = 72.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.2100	3000.000
3	1.3400	4720.000
4	3.8800	8880.000
5	4.6000	9920.000
6	6.7500	12100.000
7	9.5800	13700.000

User-specified curve number 4 at depth = 132.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.2100	6970.000
3	1.3400	11000.000
4	3.8800	20700.000
5	4.6000	23100.000
6	6.7500	28100.000
7	9.5800	32000.000

User-specified curve number 5 at depth = 132.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.1800	3500.000
3	0.5500	5010.000
4	3.7400	20700.000
5	4.1100	22400.000
6	4.8500	25000.000
7	7.8200	32900.000

User-specified curve number 6 at depth = 186.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.1800	3650.000
3	0.5500	5230.000
4	3.7400	21600.000
5	4.1100	23400.000
6	4.8500	26100.000
7	7.8200	34300.000

User-specified curve number 7 at depth = 186.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.1800	3650.000
3	0.5500	5230.000
4	3.7400	21600.000

```
5           4.1100      23400.000
6           4.8500      26100.000
7           7.8200      34300.000

User-specified curve number  8 at depth =    282.000in

Point        y              p,
No.         in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.1800       5660.000
3           0.5500       8090.000
4           3.7400      33400.000
5           4.1100      36200.000
6           4.8500      40400.000
7           7.8200      53100.000

User-specified curve number  9 at depth =    282.000in

Point        y              p,
No.         in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.2300       4150.000
3           2.8900      25900.000
4           3.0900      27200.000
5          45.9400       5730.000

User-specified curve number 10 at depth =    360.000in

Point        y              p,
No.         in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.2300       5460.000
3           0.9400       7530.000
4           2.8900      34000.000
5           3.0900      35800.000

User-specified curve number 11 at depth =    360.000in

Point        y              p,
No.         in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.2300       5460.000
3           0.9400       7530.000
4           2.8900      34000.000
5           3.0900      35800.000

User-specified curve number 12 at depth =    432.000in

Point        y              p,
No.         in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.2300       6200.000
3           0.9400       8580.000
4           2.8900      38700.000
5           3.0900      40700.000

User-specified curve number 13 at depth =    432.000in

Point        y              p,
No.         in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.0200        546.000
3           0.3600       2980.000
4           0.9700       8340.000
5           1.4500      13200.000
6           1.8300      17800.000
7           1.9600      19600.000

User-specified curve number 14 at depth =    525.000in

Point        y              p,
No.         in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.0200        745.000
```

3	0.3600	4070.000
4	0.9700	11400.000
5	1.4500	18000.000
6	1.8300	24300.000
7	1.9600	26700.000

User-specified curve number 15 at depth = 525.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.0200	745.000
3	0.3600	4070.000
4	0.9700	11400.000
5	1.4500	18000.000
6	1.8300	24300.000
7	1.9600	26700.000

User-specified curve number 16 at depth = 672.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.0200	863.000
3	0.3600	4710.000
4	0.9700	13200.000
5	1.4500	20800.000
6	1.8300	28100.000
7	1.9600	30900.000

User-specified curve number 17 at depth = 672.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.3600	5090.000
3	1.3900	10200.000
4	2.0100	16500.000
5	2.6700	24100.000
6	3.0300	27600.000
7	3.7800	32800.000

User-specified curve number 18 at depth = 702.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.3600	5220.000
3	1.3900	10500.000
4	2.0100	16900.000
5	2.6700	24700.000
6	3.0300	28300.000
7	3.7800	33700.000

User-specified curve number 19 at depth = 702.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.3600	5220.000
3	1.3900	10500.000
4	2.0100	16900.000
5	2.6700	24700.000
6	3.0300	28300.000
7	3.7800	33700.000

User-specified curve number 20 at depth = 732.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.3600	5370.000
3	1.3900	10800.000
4	2.0100	17400.000
5	2.6700	25400.000

```
6           3.0300      29100.000
7           3.7800      34700.000

User-specified curve number 21 at depth =     732.000in

Point       y              p,
No.        in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.0200        765.000
3           0.3600       4170.000
4           0.9700      11700.000
5           1.4500      18400.000
6           1.8300      24900.000
7           1.9600      27400.000

User-specified curve number 22 at depth =     792.000in

Point       y              p,
No.        in            lbs/in
-----     ----------     ----------
1           0.0000          0.000
2           0.0200        969.000
3           0.3600       5290.000
4           0.9700      14800.000
5           1.4500      23400.000
6           1.8300      31600.000
7           1.9600      34700.000


-------------------------------------------------------------------------------
Loading Type
-------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.



-------------------------------------------------------------------------------
Pile-head Loading and Pile-head Fixity Conditions
-------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =      221503.000 lbs
Bending moment at pile head =   235128000.000 in-lbs
Axial load at pile head     =      117367.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head
may rotate under the applied pile-head loading, but is not a free-head
(zero moment) condition.



-------------------------------------------------------------------------------
Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
-------------------------------------------------------------------------------

Number of sections =  1



Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                       =     132.0000 in

Material Properties:

Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =           90
Area of Single Bar                     =      1.27000 in**2
Number of Rows of Reinforcing Bars     =           45
Area of Steel                          =      114.300 in**2
```

```
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        0.835 percent
Cover Thickness (edge to bar center)   =        4.000 in

Unfactored Axial Squash Load Capacity  =     52997.63 kip
```

Distribution and Area of Steel Reinforcement

Row Number in**2	Area of Reinforcement in	Distance to Centroidal Axis
1	2.540	61.962
2	2.540	61.660
3	2.540	61.058
4	2.540	60.158
5	2.540	58.966
6	2.540	57.485
7	2.540	55.725
8	2.540	53.694
9	2.540	51.400
10	2.540	48.857
11	2.540	46.075
12	2.540	43.069
13	2.540	39.853
14	2.540	36.443
15	2.540	32.855
16	2.540	29.107
17	2.540	25.218
18	2.540	21.205
19	2.540	17.090
20	2.540	12.891
21	2.540	8.629
22	2.540	4.325
23	2.540	0.000
24	2.540	-4.325
25	2.540	-8.629
26	2.540	-12.891
27	2.540	-17.090
28	2.540	-21.205
29	2.540	-25.218
30	2.540	-29.107
31	2.540	-32.855
32	2.540	-36.443
33	2.540	-39.853
34	2.540	-43.069
35	2.540	-46.075
36	2.540	-48.857
37	2.540	-51.400
38	2.540	-53.694
39	2.540	-55.725
40	2.540	-57.485
41	2.540	-58.966
42	2.540	-60.158
43	2.540	-61.058
44	2.540	-61.660
45	2.540	-61.962

Axial Thrust Force =   0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25181408.	6.043538E+13	4.166667E-07	0.00002759	66.21742111	97.95383531	751.33747
50136430.	6.016372E+13	8.333333E-07	0.00005518	66.21697265	194.47463	1502.66409
74865067.	5.989205E+13	0.00000125	0.00008277	66.21652025	289.56242	2253.97974
99367320.	5.962039E+13	0.00000167	0.00011036	66.21605998	383.21724	3005.28408
1.236432E+08	5.934873E+13	0.00000208	0.00013795	66.21559578	475.43913	3756.57705
1.236432E+08	4.945727E+13	0.00000250	0.00007949	31.79650587	273.35193	6972.01509
1.236432E+08	4.239195E+13	0.00000292	0.00009280	31.81586856	317.99257	8132.37985
1.236432E+08	3.709296E+13	0.00000333	0.00010612	31.83531779	362.36870	9292.26830
1.236432E+08	3.297152E+13	0.00000375	0.00011946	31.85484964	406.47939	10451.67775
1.236432E+08	2.967436E+13	0.00000417	0.00013281	31.87446803	450.32382	11610.60473
1.236432E+08	2.697670E+13	0.00000458	0.00014618	31.89417690	493.90115	12769.04556
1.236432E+08	2.472864E+13	0.00000500	0.00015957	31.91396838	537.21037	13926.99812
1.236432E+08	2.282643E+13	0.00000542	0.00017298	31.93385428	580.25077	15084.45755
1.236432E+08	2.119597E+13	0.00000583	0.00018640	31.95382673	623.02128	16241.42177
1.236432E+08	1.978291E+13	0.00000625	0.00019984	31.97388965	665.52107	17397.88692
1.236432E+08	1.854648E+13	0.00000667	0.00021329	31.99404305	707.74918	18553.84972

1.236432E+08	1.745551E+13	0.00000708	0.00022677	32.01428694	749.70467	19709.30690
1.236432E+08	1.648576E+13	0.00000750	0.00024026	32.03462523	791.38666	20864.25431
1.236432E+08	1.561809E+13	0.00000792	0.00025377	32.05505794	832.79420	22018.68854
1.236432E+08	1.483718E+13	0.00000833	0.00026730	32.07558507	873.92631	23172.60617
1.236432E+08	1.413065E+13	0.00000875	0.00028084	32.09620661	914.78199	24326.00376
1.236432E+08	1.348835E+13	0.00000917	0.00029441	32.11692256	955.36025	25478.87790
1.236432E+08	1.290190E+13	0.00000958	0.00030799	32.13773686	995.66017	26631.22407
1.253513E+08	1.253513E+13	0.00001000	0.00032159	32.15864950	1035.68073	27783.03871
1.305096E+08	1.252892E+13	0.00001042	0.00033520	32.17966443	1075.42102	28934.31707
1.356625E+08	1.252269E+13	0.00001083	0.00034884	32.20077378	1114.87976	30085.05790
1.408098E+08	1.251643E+13	0.00001125	0.00036250	32.22198540	1154.05612	31235.25522
1.459517E+08	1.251015E+13	0.00001167	0.00037617	32.24330324	1192.94917	32384.90399
1.510881E+08	1.250384E+13	0.00001208	0.00038987	32.26471943	1231.55756	33534.00311
1.562189E+08	1.249751E+13	0.00001250	0.00040358	32.28624183	1269.88047	34682.54617
1.613441E+08	1.249116E+13	0.00001292	0.00041731	32.30786651	1307.91664	35830.53080
1.664637E+08	1.248477E+13	0.00001333	0.00043106	32.32959741	1345.66510	36977.95176
1.715776E+08	1.247837E+13	0.00001375	0.00044483	32.35143453	1383.12470	38124.80520
1.766858E+08	1.247194E+13	0.00001417	0.00045862	32.37338179	1420.29446	39271.08566
1.817883E+08	1.246548E+13	0.00001458	0.00047243	32.39543921	1457.17321	40416.78915
1.868850E+08	1.245900E+13	0.00001500	0.00048626	32.41760284	1493.75962	41561.91337
1.919759E+08	1.245249E+13	0.00001542	0.00050011	32.43988055	1530.05281	42706.45097
1.970610E+08	1.244596E+13	0.00001583	0.00051399	32.46227235	1566.05158	43850.39781
2.021402E+08	1.243940E+13	0.00001625	0.00052788	32.48477429	1601.75456	44993.75160
2.122808E+08	1.242619E+13	0.00001708	0.00055572	32.53012437	1672.26881	47278.65630
2.223975E+08	1.241288E+13	0.00001792	0.00058365	32.57594651	1741.58621	49561.12379
2.324898E+08	1.239946E+13	0.00001875	0.00061167	32.62224466	1809.69661	51841.11772
2.425576E+08	1.238592E+13	0.00001958	0.00063977	32.66903061	1876.59000	54118.59688
2.526004E+08	1.237227E+13	0.00002042	0.00066796	32.71631223	1942.25590	56393.52123
2.626180E+08	1.235850E+13	0.00002125	0.00069624	32.76410919	2006.68416	58665.84273
2.721121E+08	1.232206E+13	0.00002208	0.00072411	32.78967565	2068.72058	60000.00000
2.795383E+08	1.219804E+13	0.00002292	0.00074996	32.72565132	2124.87068	60000.00000
2.858830E+08	1.203718E+13	0.00002375	0.00077475	32.62121004	2177.48620	60000.00000
2.913909E+08	1.185319E+13	0.00002458	0.00079869	32.48905045	2227.16671	60000.00000
2.963306E+08	1.165891E+13	0.00002542	0.00082203	32.34232360	2274.58154	60000.00000
3.007969E+08	1.145893E+13	0.00002625	0.00084487	32.18566364	2319.98265	60000.00000
3.048770E+08	1.125700E+13	0.00002708	0.00086729	32.02311462	2363.60474	60000.00000
3.086357E+08	1.105561E+13	0.00002792	0.00088936	31.85755616	2405.62971	60000.00000
3.120117E+08	1.085258E+13	0.00002875	0.00091096	31.68568772	2445.90409	60000.00000
3.151933E+08	1.065442E+13	0.00002958	0.00093235	31.51608127	2484.93178	60000.00000
3.181679E+08	1.046031E+13	0.00003042	0.00095350	31.34785169	2522.69974	60000.00000
3.208838E+08	1.026828E+13	0.00003125	0.00097431	31.17791480	2559.06830	60000.00000
3.235065E+08	1.008332E+13	0.00003208	0.00099503	31.01396137	2594.50546	60000.00000
3.258804E+08	9.900165E+12	0.00003292	0.00101541	30.84788758	2628.58566	60000.00000
3.283735E+08	9.729584E+12	0.00003375	0.00103936	30.79570431	2667.96070	60000.00000
3.305070E+08	9.556830E+12	0.00003458	0.00105898	30.62122375	2699.19589	60000.00000
3.324844E+08	9.387796E+12	0.00003542	0.00107837	30.44806498	2729.35608	60000.00000
3.344561E+08	9.226374E+12	0.00003625	0.00109779	30.28375357	2758.90365	60000.00000
3.361933E+08	9.065887E+12	0.00003708	0.00111678	30.11552793	2787.13879	60000.00000
3.378986E+08	8.911611E+12	0.00003792	0.00113576	29.95411187	2814.70462	60000.00000
3.395986E+08	8.763835E+12	0.00003875	0.00115477	29.80043381	2841.68159	60000.00000
3.410842E+08	8.616863E+12	0.00003958	0.00117336	29.64275891	2867.42591	60000.00000
3.425468E+08	8.475384E+12	0.00004042	0.00119194	29.49135464	2892.54946	60000.00000
3.440045E+08	8.339502E+12	0.00004125	0.00121055	29.34677964	2917.10627	60000.00000
3.453646E+08	8.206683E+12	0.00004208	0.00122898	29.20355004	2940.80774	60000.00000
3.466128E+08	8.076414E+12	0.00004292	0.00124719	29.06078070	2963.62760	60000.00000
3.478564E+08	7.951003E+12	0.00004375	0.00126543	28.92408925	2985.90138	60000.00000
3.490955E+08	7.830178E+12	0.00004458	0.00128369	28.79314131	3007.62660	60000.00000
3.502570E+08	7.712081E+12	0.00004542	0.00130180	28.66357809	3028.57976	60000.00000
3.506722E+08	7.582101E+12	0.00004625	0.00132275	28.59999830	3052.26388	60000.00000
3.526325E+08	7.489539E+12	0.00004708	0.00134318	28.52766949	3074.58539	60000.00000
3.536482E+08	7.380485E+12	0.00004792	0.00136049	28.39274830	3092.76550	60000.00000
3.546602E+08	7.275081E+12	0.00004875	0.00137782	28.26298445	3110.45125	60000.00000
3.555833E+08	7.171429E+12	0.00004958	0.00139492	28.13280362	3127.36882	60000.00000
3.572817E+08	6.971350E+12	0.00005125	0.00142876	27.87832314	3159.33829	60000.00000
3.589660E+08	6.783609E+12	0.00005292	0.00146271	27.64178127	3189.40607	60000.00000
3.605100E+08	6.604763E+12	0.00005458	0.00149633	27.41359109	3217.18780	60000.00000
3.619065E+08	6.433893E+12	0.00005625	0.00152958	27.19245046	3242.72053	60000.00000
3.632898E+08	6.272629E+12	0.00005792	0.00156292	26.98574334	3266.40488	60000.00000
3.646301E+08	6.119666E+12	0.00005958	0.00159626	26.79034621	3288.14756	60000.00000
3.657706E+08	5.971764E+12	0.00006125	0.00162897	26.59535033	3307.58501	60000.00000
3.668986E+08	5.831501E+12	0.00006292	0.00166177	26.41222304	3325.22083	60000.00000
3.683458E+08	5.703419E+12	0.00006458	0.00170424	26.38820261	3345.53088	60000.00000
3.693951E+08	5.575775E+12	0.00006625	0.00173585	26.20158201	3358.37736	60000.00000
3.702605E+08	5.451689E+12	0.00006792	0.00176669	26.01267189	3369.23024	60000.00000
3.711042E+08	5.333234E+12	0.00006958	0.00179757	25.83327788	3378.45625	60000.00000
3.719375E+08	5.220176E+12	0.00007125	0.00182853	25.66355735	3386.06356	60000.00000
3.727603E+08	5.112142E+12	0.00007292	0.00185958	25.50286120	3392.03686	60000.00000
3.735690E+08	5.008747E+12	0.00007458	0.00189071	25.35032791	3396.35813	60000.00000
3.742233E+08	4.907847E+12	0.00007625	0.00192109	25.19463569	3398.96330	60000.00000
3.748678E+08	4.811137E+12	0.00007792	0.00195156	25.04676408	3399.98441	60000.00000
3.754819E+08	4.718097E+12	0.00007958	0.00198212	24.90622920	3393.47093	60000.00000

3.760877E+08	4.628772E+12	0.00008125	0.00201277	24.77259833	3385.85592	60000.00000
3.766889E+08	4.542982E+12	0.00008292	0.00204352	24.64547020	3390.28101	60000.00000
3.772852E+08	4.460514E+12	0.00008458	0.00207436	24.52446717	3394.58368	60000.00000
3.777768E+08	4.380021E+12	0.00008625	0.00210460	24.40119034	3397.57963	60000.00000
3.782499E+08	4.302369E+12	0.00008792	0.00213484	24.28250831	3399.38470	60000.00000
3.782499E+08	4.222325E+12	0.00008958	0.00216792	24.19999856	3399.35998	60000.00000
3.785457E+08	4.148446E+12	0.00009125	0.00220825	24.19999856	3390.15594	60000.00000
3.799668E+08	4.089329E+12	0.00009292	0.00224281	24.13785464	3382.47763	60000.00000
3.803819E+08	4.021659E+12	0.00009458	0.00227198	24.02094680	3386.43806	60000.00000
3.807947E+08	3.956308E+12	0.00009625	0.00230122	23.90880686	3390.65692	60000.00000
3.812051E+08	3.893158E+12	0.00009792	0.00233053	23.80120665	3394.10273	60000.00000
3.815485E+08	3.831449E+12	0.00009958	0.00235927	23.69145066	3396.69455	60000.00000
3.818629E+08	3.771485E+12	0.00010125	0.00238781	23.58331937	3398.52615	60000.00000
3.821752E+08	3.713443E+12	0.00010292	0.00241642	23.47933835	3399.63052	60000.00000
3.824854E+08	3.657231E+12	0.00010458	0.00244509	23.37932271	3399.99740	60000.00000
3.827868E+08	3.602699E+12	0.00010625	0.00247398	23.28455490	3394.78418	60000.00000
3.830870E+08	3.549841E+12	0.00010792	0.00250293	23.19314665	3389.55864	60000.00000
3.833650E+08	3.498388E+12	0.00010958	0.00253235	23.10890204	3384.20618	60000.00000
3.836295E+08	3.448355E+12	0.00011125	0.00256208	23.02995247	3378.77226	60000.00000
3.838801E+08	3.399676E+12	0.00011292	0.00259213	22.95616418	3378.93161	60000.00000
3.841291E+08	3.352399E+12	0.00011458	0.00262224	22.88501555	3383.58659	60000.00000
3.843353E+08	3.306110E+12	0.00011625	0.00265216	22.81430358	3387.62034	60000.00000
3.846572E+08	3.216645E+12	0.00011958	0.00271194	22.67823368	3393.97390	60000.00000
3.849731E+08	3.131985E+12	0.00012292	0.00277195	22.55147141	3398.08523	60000.00000
3.852586E+08	3.051553E+12	0.00012625	0.00283283	22.43823391	3399.91839	60000.00000
3.855131E+08	2.975021E+12	0.00012958	0.00289462	22.33791929	3392.87606	60000.00000
3.857602E+08	2.902271E+12	0.00013292	0.00295670	22.24478406	3383.25441	60000.00000
3.860036E+08	2.833054E+12	0.00013625	0.00301896	22.15749854	3373.58622	60000.00000
3.862154E+08	2.766917E+12	0.00013958	0.00308218	22.08129877	3372.04150	60000.00000
3.863390E+08	2.703247E+12	0.00014292	0.00314428	22.00082678	3380.81542	60000.00000
3.878648E+08	2.652067E+12	0.00014625	0.00321750	22.00000066	3390.22842	60000.00000
3.893390E+08	2.602824E+12	0.00014958	0.00329083	22.00000066	3396.50984	60000.00000
3.907463E+08	2.555289E+12	0.00015292	0.00336417	22.00000066	3399.62741	60000.00000
3.918816E+08	2.508043E+12	0.00015625	0.00343750	22.00000066	3394.51569	60000.00000
3.918816E+08	2.455655E+12	0.00015958	0.00350985	21.99381262	3384.11931	60000.00000
3.918816E+08	2.405412E+12	0.00016292	0.00357301	21.93154281	3376.14802	60000.00000
3.918816E+08	2.357183E+12	0.00016625	0.00363634	21.87275058	3368.13365	60000.00000
3.918816E+08	2.310850E+12	0.00016958	0.00369984	21.81725496	3360.07514	60000.00000
3.918816E+08	2.266304E+12	0.00017292	0.00376351	21.76489466	3361.62745	60000.00000
3.918816E+08	2.223442E+12	0.00017625	0.00382736	21.71552414	3370.17444	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 385929.47495 in-kip

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Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head =   221503.000 lbs
Specified moment at pile head   =   235128000.000 in-lbs
Specified axial load at pile head   =   117367.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	1.979	2.35E+08	2.22E+05	-0.009631	1049.893	1.24E+13	0.000	0.000
4.800	1.933	2.36E+08	2.22E+05	-0.009540	1054.625	1.24E+13	0.000	0.000
9.600	1.887	2.37E+08	2.22E+05	-0.009448	1059.358	1.24E+13	0.000	0.000
14.400	1.842	2.38E+08	2.22E+05	-0.009356	1064.090	1.24E+13	0.000	0.000
19.200	1.798	2.39E+08	2.22E+05	-0.009264	1068.822	1.24E+13	0.000	0.000
24.000	1.753	2.40E+08	2.22E+05	-0.009171	1073.553	1.24E+13	0.000	0.000
28.800	1.710	2.42E+08	2.22E+05	-0.009077	1078.285	1.24E+13	0.000	0.000
33.600	1.666	2.43E+08	2.22E+05	-0.008984	1083.016	1.24E+13	0.000	0.000
38.400	1.623	2.44E+08	2.22E+05	-0.008889	1087.747	1.24E+13	0.000	0.000
43.200	1.581	2.45E+08	2.12E+05	-0.008795	1092.478	1.24E+13	-3803.450	11548.
48.000	1.539	2.46E+08	1.94E+05	-0.008700	1096.820	1.24E+13	-3967.950	12376.
52.800	1.497	2.47E+08	1.74E+05	-0.008604	1100.757	1.24E+13	-4127.173	13230.
57.600	1.456	2.47E+08	1.54E+05	-0.008508	1104.273	1.24E+13	-4281.217	14111.
62.400	1.416	2.48E+08	1.33E+05	-0.008412	1107.352	1.24E+13	-4430.181	15021.
67.200	1.376	2.49E+08	1.12E+05	-0.008316	1109.979	1.24E+13	-4574.164	15961.
72.000	1.336	2.49E+08	89306.	-0.008220	1112.138	1.24E+13	-4713.743	16937.
76.800	1.297	2.50E+08	65635.	-0.008123	1113.817	1.24E+13	-5149.356	19062.
81.600	1.258	2.50E+08	39901.	-0.008026	1114.969	1.24E+13	-5573.000	21266.
86.400	1.220	2.50E+08	12162.	-0.007929	1115.553	1.24E+13	-5984.903	23555.
91.200	1.182	2.50E+08	-17526.	-0.007832	1115.526	1.24E+13	-6385.295	25935.
96.000	1.144	2.50E+08	-49110.	-0.007735	1114.847	1.24E+13	-6774.403	28414.

100.800	1.108	2.49E+08	-82534.	-0.007638	1113.477	1.24E+13	-7152.455	30999.
105.600	1.071	2.49E+08	-1.18E+05	-0.007542	1111.376	1.24E+13	-7519.678	33699.
110.400	1.035	2.48E+08	-1.55E+05	-0.007445	1108.508	1.24E+13	-7876.296	36523.
115.200	0.999621	2.48E+08	-1.93E+05	-0.007349	1104.836	1.24E+13	-8222.534	39483.
120.000	0.964576	2.47E+08	-2.34E+05	-0.007253	1100.325	1.24E+13	-8558.614	42590.
124.800	0.929989	2.45E+08	-2.75E+05	-0.007158	1094.940	1.24E+13	-8884.755	45857.
129.600	0.895859	2.44E+08	-3.19E+05	-0.007063	1088.649	1.24E+13	-9201.174	49300.
134.400	0.862183	2.42E+08	-3.57E+05	-0.006969	1081.418	1.24E+13	-6558.216	36511.
139.200	0.828957	2.40E+08	-3.88E+05	-0.006875	1073.518	1.24E+13	-6419.322	37170.
144.000	0.796179	2.39E+08	-4.18E+05	-0.006783	1064.963	1.24E+13	-6281.389	37869.
148.800	0.763844	2.36E+08	-4.48E+05	-0.006691	1055.766	1.24E+13	-6144.426	38612.
153.600	0.731948	2.34E+08	-4.77E+05	-0.006600	1045.943	1.24E+13	-6008.436	39402.
158.400	0.700488	2.32E+08	-5.06E+05	-0.006509	1035.506	1.24E+13	-5873.424	40247.
163.200	0.669459	2.29E+08	-5.34E+05	-0.006420	1024.469	1.24E+13	-5739.392	41151.
168.000	0.638855	2.27E+08	-5.61E+05	-0.006332	1012.847	1.24E+13	-5606.341	42123.
172.800	0.608673	2.24E+08	-5.88E+05	-0.006245	1000.652	1.24E+13	-5474.269	43170.
177.600	0.578907	2.21E+08	-6.13E+05	-0.006159	987.899	1.24E+13	-5343.173	44303.
182.400	0.549551	2.18E+08	-6.39E+05	-0.006074	974.600	1.24E+13	-5213.438	45536.
187.200	0.520600	2.15E+08	-6.64E+05	-0.005990	960.769	1.24E+13	-5139.376	47386.
192.000	0.492048	2.12E+08	-6.88E+05	-0.005908	946.413	1.24E+13	-5152.974	50268.
196.800	0.463888	2.08E+08	-7.13E+05	-0.005826	931.532	1.24E+13	-5161.791	53411.
201.600	0.436114	2.05E+08	-7.38E+05	-0.005747	916.123	1.24E+13	-5165.932	56858.
206.400	0.408720	2.01E+08	-7.63E+05	-0.005668	900.187	1.24E+13	-5165.499	60663.
211.200	0.381699	1.98E+08	-7.87E+05	-0.005591	883.724	1.24E+13	-5160.591	64896.
216.000	0.355044	1.94E+08	-8.12E+05	-0.005516	866.734	1.25E+13	-5151.300	69643.
220.800	0.328748	1.90E+08	-8.37E+05	-0.005442	849.218	1.25E+13	-5137.716	75015.
225.600	0.302802	1.86E+08	-8.62E+05	-0.005370	831.178	1.25E+13	-5119.922	81161.
230.400	0.277200	1.82E+08	-8.86E+05	-0.005299	812.616	1.25E+13	-5098.001	88277.
235.200	0.251934	1.77E+08	-9.10E+05	-0.005230	793.532	1.25E+13	-5072.025	96635.
240.000	0.226995	1.73E+08	-9.35E+05	-0.005162	773.932	1.25E+13	-5042.068	1.07E+05
244.800	0.202375	1.68E+08	-9.59E+05	-0.005097	753.816	1.25E+13	-5008.193	1.19E+05
249.600	0.178066	1.64E+08	-9.83E+05	-0.005033	733.189	1.25E+13	-4928.092	1.33E+05
254.400	0.154058	1.59E+08	-1.00E+06	-0.004971	712.060	1.25E+13	-4349.686	1.36E+05
259.200	0.130344	1.54E+08	-1.02E+06	-0.004911	690.486	1.25E+13	-3752.906	1.38E+05
264.000	0.106913	1.49E+08	-1.04E+06	-0.004853	668.529	1.25E+13	-3137.974	1.41E+05
268.800	0.083757	1.44E+08	-1.05E+06	-0.004797	646.252	1.25E+13	-2505.089	1.44E+05
273.600	0.060866	1.39E+08	-1.06E+06	-0.004742	623.720	1.25E+13	-1854.425	1.46E+05
278.400	0.038231	1.34E+08	-1.07E+06	-0.004690	600.997	1.25E+13	-1186.129	1.49E+05
283.200	0.015841	1.29E+08	-1.08E+06	-0.004640	578.154	1.25E+13	-287.219	87029.
288.000	-0.006312	1.23E+08	-1.08E+06	-0.004610	555.281	5.94E+13	116.649	88712.
292.800	-0.028417	1.18E+08	-1.07E+06	-0.004600	532.420	5.94E+13	535.143	90394.
297.600	-0.050476	1.13E+08	-1.07E+06	-0.004591	509.614	5.95E+13	968.254	92077.
302.400	-0.072491	1.08E+08	-1.07E+06	-0.004582	486.907	5.95E+13	1415.971	93759.
307.200	-0.094464	1.03E+08	-1.06E+06	-0.004574	464.344	5.96E+13	1878.289	95441.
312.000	-0.116398	9.79E+07	-1.05E+06	-0.004566	441.972	5.96E+13	2355.206	97124.
316.800	-0.138294	9.29E+07	-1.03E+06	-0.004558	419.841	5.97E+13	2846.720	98806.
321.600	-0.160153	8.79E+07	-1.02E+06	-0.004551	398.000	5.97E+13	3352.832	1.00E+05
326.400	-0.181979	8.31E+07	-1.00E+06	-0.004544	376.502	5.98E+13	3873.546	1.02E+05
331.200	-0.203773	7.83E+07	-9.83E+05	-0.004537	355.398	5.98E+13	4408.868	1.04E+05
336.000	-0.225537	7.36E+07	-9.60E+05	-0.004531	334.745	5.99E+13	4958.804	1.06E+05
340.800	-0.247273	6.91E+07	-9.36E+05	-0.004525	314.597	5.99E+13	5210.261	1.01E+05
345.600	-0.268982	6.47E+07	-9.10E+05	-0.004520	294.982	6.00E+13	5369.664	95822.
350.400	-0.290666	6.04E+07	-3.84E+05	-0.004515	275.914	6.00E+13	5514.921	91072.
355.200	-0.312327	5.62E+07	-3.57E+05	-0.004510	257.408	6.01E+13	5646.062	86772.
360.000	-0.333966	5.21E+07	-3.30E+05	-0.004506	239.479	6.01E+13	5763.113	82832.
364.800	-0.355586	4.82E+07	-3.02E+05	-0.004502	222.138	6.02E+13	5879.134	79362.
369.600	-0.377187	4.44E+07	-7.74E+05	-0.004498	205.397	6.02E+13	5996.359	76308.
374.400	-0.398771	4.08E+07	-7.45E+05	-0.004495	189.267	6.02E+13	6114.790	73604.
379.200	-0.420339	3.73E+07	-7.15E+05	-0.004492	173.762	6.03E+13	6234.430	71193.
384.000	-0.441893	3.39E+07	-6.85E+05	-0.004489	158.893	6.03E+13	6355.283	69033.
388.800	-0.463434	3.07E+07	-6.54E+05	-0.004487	144.672	6.03E+13	6477.350	67089.
393.600	-0.484963	2.77E+07	-6.23E+05	-0.004484	131.112	6.04E+13	6600.634	65331.
398.400	-0.506482	2.48E+07	-5.91E+05	-0.004482	118.225	6.04E+13	6725.138	63735.
403.200	-0.527992	2.20E+07	-5.58E+05	-0.004480	106.025	6.04E+13	6850.865	62282.
408.000	-0.549493	1.94E+07	-5.25E+05	-0.004479	94.524	6.04E+13	6977.817	60954.
412.800	-0.570986	1.70E+07	-4.91E+05	-0.004477	83.735	6.04E+13	7105.997	59737.
417.600	-0.592473	1.47E+07	-4.57E+05	-0.004476	73.671	6.04E+13	7235.407	58619.
422.400	-0.613955	1.26E+07	-4.22E+05	-0.004475	64.345	6.04E+13	7366.050	57589.
427.200	-0.635431	1.07E+07	-3.86E+05	-0.004474	55.771	6.04E+13	7497.927	56639.
432.000	-0.656904	8.89E+06	-3.50E+05	-0.004473	47.962	6.04E+13	7631.041	55760.
436.800	-0.678373	7.31E+06	-3.17E+05	-0.004472	40.931	6.04E+13	5886.836	41654.
441.600	-0.699840	5.85E+06	-2.88E+05	-0.004472	34.501	6.04E+13	6191.941	42469.
446.400	-0.721304	4.54E+06	-2.58E+05	-0.004472	28.703	6.04E+13	6504.182	43283.
451.200	-0.742767	3.39E+06	-2.26E+05	-0.004471	23.569	6.04E+13	6823.563	44096.
456.000	-0.764228	2.38E+06	-1.92E+05	-0.004471	19.131	6.04E+13	7150.085	44909.
460.800	-0.785688	1.55E+06	-1.57E+05	-0.004471	15.423	6.04E+13	7483.754	45720.
465.600	-0.807148	8.81E+05	-1.20E+05	-0.004471	12.478	6.04E+13	7824.570	46532.
470.400	-0.828607	3.96E+05	-81883.	-0.004471	10.331	6.04E+13	8172.537	47342.
475.200	-0.850066	99893.	-41802.	-0.004471	9.019	6.04E+13	8527.657	48152.
480.000	-0.871526	0.000	0.000	-0.004471	8.576	6.04E+13	8889.930	24481.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	1.97904444 in
Computed slope at pile head	=	-0.00963135
Maximum bending moment	=	2.499541E+08 lbs-in
Maximum shear force	=	-1076229. lbs
Depth of maximum bending moment	=	86.40000000 in
Depth of maximum shear force	=	288.00000 in
Number of iterations	=	48
Number of zero deflection points	=	1

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 2.22E+05	M= 2.35E+08	117367.	1.9790	2.4995E+08	-1076229.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

Shear = 221503. lbs
Moment = 235128000. in-lbs
Axial Load = 117367. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
480.000	1.97904444	2.499541E+08	-1076229.
456.000	2.39075417	2.499718E+08	-1134946.
432.000	2.72707698	2.492359E+08	-1186709.
408.000	3.23877406	2.491682E+08	-1477559.
384.000	3.80389079	2.483103E+08	-1341437.
360.000	4.65036586	2.480753E+08	-1437544.
336.000	5.83584546	2.477792E+08	-1544059.
312.000	7.76185989	2.474868E+08	-1678025.
288.000	11.23250814	2.471984E+08	-1863679.
264.000	17.91554341	2.471911E+08	-2113467.

The analysis ended normally.

B.2 Using P-y Curves from the PMT (Ultimate)

```
===============================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.47)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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                              All Rights Reserved

===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                           Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled SHaft Analysis Using PMT Data Adjusted.lpd
Name of output file:         Drilled SHaft Analysis Using PMT Data Adjusted.lpo
Name of plot output file:    Drilled SHaft Analysis Using PMT Data Adjusted.lpp
Name of runtime file:        Drilled SHaft Analysis Using PMT Data Adjusted.lpr


-----------------------------------------------------------------------------
                         Time and Date of Analysis
-----------------------------------------------------------------------------

               Date:  October 11, 2012     Time:  13:39:13


-----------------------------------------------------------------------------
                               Problem Title
-----------------------------------------------------------------------------

Drilled Shaft Analysis Using PMT Data


-----------------------------------------------------------------------------
                              Program Options
-----------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- User-specified p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs.
  pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1
```

Pile Structural Properties and Geometry

Pile Length = 480.00 in

Depth of ground surface below top of pile = 12.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	132.00000	14902723.	13685.0000	3604997.
2	480.0000	132.00000	14902723.	13685.0000	3604997.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of moment of inertia and modulus of are not used for any computations other than total stress due to combined axial loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 11 layers

Layer 1 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 12.000 in
Distance from top of pile to bottom of layer = 72.000 in

Layer 2 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 72.000 in
Distance from top of pile to bottom of layer = 132.000 in

Layer 3 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 186.000 in

Layer 4 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 186.000 in
Distance from top of pile to bottom of layer = 282.000 in

Layer 5 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 282.000 in
Distance from top of pile to bottom of layer = 360.000 in

Layer 6 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 360.000 in
Distance from top of pile to bottom of layer = 432.000 in

Layer 7 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 432.000 in
Distance from top of pile to bottom of layer = 525.000 in

Layer 8 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 525.000 in
Distance from top of pile to bottom of layer = 672.000 in

Layer 9 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 672.000 in
Distance from top of pile to bottom of layer = 702.000 in

Layer 10 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 702.000 in
Distance from top of pile to bottom of layer = 732.000 in

Layer 11 is modelled using user-specified p-y curves
Distance from top of pile to top of layer = 732.000 in
Distance from top of pile to bottom of layer = 792.000 in

(Depth of lowest layer extends 312.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 22 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06800
6	186.00	0.06800
7	186.00	0.06800
8	282.00	0.06800
9	282.00	0.07200
10	360.00	0.07200
11	360.00	0.06400
12	432.00	0.06400
13	432.00	0.07400
14	525.00	0.07400
15	525.00	0.07100
16	672.00	0.07100
17	672.00	0.07200
18	702.00	0.07200
19	702.00	0.07200
20	732.00	0.07200
21	732.00	0.07100
22	792.00	0.07100

Shear Strength of Soils

Shear strength parameters with depth defined using 0 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.001	1.0000	1.0000
4	792.000	1.0000	1.0000

User-specified p-y Curves

User-specified p-y curves defined using 22 curves.

User-specified curve number 1 at depth = 12.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000

```
  2          0.2100       1390.000
  3          1.3400       2200.000
  4          3.8800       4130.000
  5          4.6000       4620.000
  6          6.7500       5610.000
  7          9.5800       6390.000

User-specified curve number  2 at depth =     72.000in

Point       y               p,
 No.        in            lbs/in
-----    ----------     ----------
  1          0.0000          0.000
  2          0.2100       3000.000
  3          1.3400       4720.000
  4          3.8800       8880.000
  5          4.6000       9920.000
  6          6.7500      12100.000
  7          9.5800      13700.000

User-specified curve number  3 at depth =     72.000in

Point       y               p,
 No.        in            lbs/in
-----    ----------     ----------
  1          0.0000          0.000
  2          0.2100       3000.000
  3          1.3400       4720.000
  4          3.8800       8880.000
  5          4.6000       9920.000
  6          6.7500      12100.000
  7          9.5800      13700.000

User-specified curve number  4 at depth =    132.000in

Point       y               p,
 No.        in            lbs/in
-----    ----------     ----------
  1          0.0000          0.000
  2          0.2100       6970.000
  3          1.3400      11000.000
  4          3.8800      20700.000
  5          4.6000      23100.000
  6          6.7500      28100.000
  7          9.5800      32000.000

User-specified curve number  5 at depth =    132.000in

Point       y               p,
 No.        in            lbs/in
-----    ----------     ----------
  1          0.0000          0.000
  2          0.1800       3500.000
  3          0.5500       5010.000
  4          3.7400      20700.000
  5          4.1100      22400.000
  6          4.8500      25000.000
  7          7.8200      32900.000

User-specified curve number  6 at depth =    186.000in

Point       y               p,
 No.        in            lbs/in
-----    ----------     ----------
  1          0.0000          0.000
  2          0.1800       3650.000
  3          0.5500       5230.000
  4          3.7400      21600.000
  5          4.1100      23400.000
  6          4.8500      26100.000
  7          7.8200      34300.000

User-specified curve number  7 at depth =    186.000in

Point       y               p,
 No.        in            lbs/in
-----    ----------     ----------
  1          0.0000          0.000
  2          0.1800       3650.000
  3          0.5500       5230.000
  4          3.7400      21600.000
```

5	4.1100	23400.000
6	4.8500	26100.000
7	7.8200	34300.000

User-specified curve number 8 at depth = 282.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.1800	5660.000
3	0.5500	8090.000
4	3.7400	33400.000
5	4.1100	36200.000
6	4.8500	40400.000
7	7.8200	53100.000

User-specified curve number 9 at depth = 282.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.2300	4150.000
3	2.8900	25900.000
4	3.0900	27200.000
5	45.9400	5730.000

User-specified curve number 10 at depth = 360.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.2300	5460.000
3	0.9400	7530.000
4	2.8900	34000.000
5	3.0900	35800.000

User-specified curve number 11 at depth = 360.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.2300	5460.000
3	0.9400	7530.000
4	2.8900	34000.000
5	3.0900	35800.000

User-specified curve number 12 at depth = 432.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.2300	6200.000
3	0.9400	8580.000
4	2.8900	38700.000
5	3.0900	40700.000

User-specified curve number 13 at depth = 432.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.0200	546.000
3	0.3600	2980.000
4	0.9700	8340.000
5	1.4500	13200.000
6	1.8300	17800.000
7	1.9600	19600.000

User-specified curve number 14 at depth = 525.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.0200	745.000

3	0.3600	4070.000
4	0.9700	11400.000
5	1.4500	18000.000
6	1.8300	24300.000
7	1.9600	26700.000

User-specified curve number 15 at depth = 525.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.0200	745.000
3	0.3600	4070.000
4	0.9700	11400.000
5	1.4500	18000.000
6	1.8300	24300.000
7	1.9600	26700.000

User-specified curve number 16 at depth = 672.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.0200	863.000
3	0.3600	4710.000
4	0.9700	13200.000
5	1.4500	20800.000
6	1.8300	28100.000
7	1.9600	30900.000

User-specified curve number 17 at depth = 672.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.3600	5090.000
3	1.3900	10200.000
4	2.0100	16500.000
5	2.6700	24100.000
6	3.0300	27600.000
7	3.7800	32800.000

User-specified curve number 18 at depth = 702.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.3600	5220.000
3	1.3900	10500.000
4	2.0100	16900.000
5	2.6700	24700.000
6	3.0300	28300.000
7	3.7800	33700.000

User-specified curve number 19 at depth = 702.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.3600	5220.000
3	1.3900	10500.000
4	2.0100	16900.000
5	2.6700	24700.000
6	3.0300	28300.000
7	3.7800	33700.000

User-specified curve number 20 at depth = 732.000in

Point No.	y in	p, lbs/in
1	0.0000	0.000
2	0.3600	5370.000
3	1.3900	10800.000
4	2.0100	17400.000
5	2.6700	25400.000

```
  6          3.0300      29100.000
  7          3.7800      34700.000

User-specified curve number 21 at depth =    732.000in

Point       y              p,
 No.        in            lbs/in
-----     ----------     ----------
  1          0.0000          0.000
  2          0.0200        765.000
  3          0.3600       4170.000
  4          0.9700      11700.000
  5          1.4500      18400.000
  6          1.8300      24900.000
  7          1.9600      27400.000

User-specified curve number 22 at depth =    792.000in

Point       y              p,
 No.        in            lbs/in
-----     ----------     ----------
  1          0.0000          0.000
  2          0.0200        969.000
  3          0.3600       5290.000
  4          0.9700      14800.000
  5          1.4500      23400.000
  6          1.8300      31600.000
  7          1.9600      34700.000


--------------------------------------------------------------------------------
                                Loading Type
--------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.



--------------------------------------------------------------------------------
              Pile-head Loading and Pile-head Fixity Conditions
--------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =      319693.000 lbs
Bending moment at pile head =   345051000.000 in-lbs
Axial load at pile head     =      189766.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head
may rotate under the applied pile-head loading, but is not a free-head
(zero moment) condition.



--------------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

Number of sections =  1



Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                      =     132.0000 in

Material Properties:

Compressive Strength of Concrete      =        4.000 kip/in**2
Yield Stress of Reinforcement         =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars            =           90
Area of Single Bar                    =      1.27000 in**2
Number of Rows of Reinforcing Bars    =           45
Area of Steel                         =      114.300 in**2
```

```
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        0.835 percent
Cover Thickness (edge to bar center)   =        4.000 in

Unfactored Axial Squash Load Capacity  =     52997.63 kip
```

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	2.540	61.962
2	2.540	61.660
3	2.540	61.058
4	2.540	60.158
5	2.540	58.966
6	2.540	57.485
7	2.540	55.725
8	2.540	53.694
9	2.540	51.400
10	2.540	48.857
11	2.540	46.075
12	2.540	43.069
13	2.540	39.853
14	2.540	36.443
15	2.540	32.855
16	2.540	29.107
17	2.540	25.218
18	2.540	21.205
19	2.540	17.090
20	2.540	12.891
21	2.540	8.629
22	2.540	4.325
23	2.540	0.000
24	2.540	-4.325
25	2.540	-8.629
26	2.540	-12.891
27	2.540	-17.090
28	2.540	-21.205
29	2.540	-25.218
30	2.540	-29.107
31	2.540	-32.855
32	2.540	-36.443
33	2.540	-39.853
34	2.540	-43.069
35	2.540	-46.075
36	2.540	-48.857
37	2.540	-51.400
38	2.540	-53.694
39	2.540	-55.725
40	2.540	-57.485
41	2.540	-58.966
42	2.540	-60.158
43	2.540	-61.058
44	2.540	-61.660
45	2.540	-61.962

Axial Thrust Force =   0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25181408.	6.043538E+13	4.166667E-07	0.00002759	66.21742111	97.95383531	751.33747
50136430.	6.016372E+13	8.333333E-07	0.00005518	66.21697265	194.47463	1502.66409
74865067.	5.989205E+13	0.00000125	0.00008277	66.21652025	289.56242	2253.97974
99367320.	5.962039E+13	0.00000167	0.00011036	66.21605998	383.21724	3005.28408
1.236432E+08	5.934873E+13	0.00000208	0.00013795	66.21559578	475.43913	3756.57705
1.236432E+08	4.945727E+13	0.00000250	0.00007949	31.79650587	273.35193	6972.01509
1.236432E+08	4.239195E+13	0.00000292	0.00009280	31.81586856	317.99257	8132.37985
1.236432E+08	3.709296E+13	0.00000333	0.00010612	31.83531779	362.36870	9292.26830
1.236432E+08	3.297152E+13	0.00000375	0.00011946	31.85484964	406.47939	10451.67775
1.236432E+08	2.967436E+13	0.00000417	0.00013281	31.87446803	450.32382	11610.60473
1.236432E+08	2.697670E+13	0.00000458	0.00014618	31.89417690	493.90115	12769.04556
1.236432E+08	2.472864E+13	0.00000500	0.00015957	31.91396838	537.21037	13926.99812
1.236432E+08	2.282643E+13	0.00000542	0.00017298	31.93385428	580.25077	15084.45755
1.236432E+08	2.119597E+13	0.00000583	0.00018640	31.95382673	623.02128	16241.42177
1.236432E+08	1.978291E+13	0.00000625	0.00019984	31.97388965	665.52107	17397.88692
1.236432E+08	1.854648E+13	0.00000667	0.00021329	31.99404305	707.74918	18553.84972

1.236432E+08	1.745551E+13	0.00000708	0.00022677	32.01428694	749.70467	19709.30690
1.236432E+08	1.648576E+13	0.00000750	0.00024026	32.03462523	791.38666	20864.25431
1.236432E+08	1.561809E+13	0.00000792	0.00025377	32.05505794	832.79420	22018.68854
1.236432E+08	1.483718E+13	0.00000833	0.00026730	32.07558507	873.92631	23172.60617
1.236432E+08	1.413065E+13	0.00000875	0.00028084	32.09620661	914.78199	24326.00376
1.236432E+08	1.348835E+13	0.00000917	0.00029441	32.11692256	955.36025	25478.87790
1.236432E+08	1.290190E+13	0.00000958	0.00030799	32.13773686	995.66017	26631.22407
1.253513E+08	1.253513E+13	0.00001000	0.00032159	32.15864950	1035.68073	27783.03871
1.305096E+08	1.252892E+13	0.00001042	0.00033520	32.17966443	1075.42102	28934.31707
1.356625E+08	1.252269E+13	0.00001083	0.00034884	32.20077378	1114.87976	30085.05790
1.408098E+08	1.251643E+13	0.00001125	0.00036250	32.22198540	1154.05612	31235.25522
1.459517E+08	1.251015E+13	0.00001167	0.00037617	32.24330324	1192.94917	32384.90399
1.510881E+08	1.250384E+13	0.00001208	0.00038987	32.26471943	1231.55756	33534.00311
1.562189E+08	1.249751E+13	0.00001250	0.00040358	32.28624183	1269.88047	34682.54617
1.613441E+08	1.249116E+13	0.00001292	0.00041731	32.30786651	1307.91664	35830.53080
1.664637E+08	1.248477E+13	0.00001333	0.00043106	32.32959741	1345.66510	36977.95176
1.715776E+08	1.247837E+13	0.00001375	0.00044483	32.35143453	1383.12470	38124.80520
1.766858E+08	1.247194E+13	0.00001417	0.00045862	32.37338179	1420.29446	39271.08566
1.817883E+08	1.246548E+13	0.00001458	0.00047243	32.39543921	1457.17321	40416.78915
1.868850E+08	1.245900E+13	0.00001500	0.00048626	32.41760284	1493.75962	41561.91337
1.919759E+08	1.245249E+13	0.00001542	0.00050011	32.43988055	1530.05281	42706.45097
1.970610E+08	1.244596E+13	0.00001583	0.00051399	32.46227235	1566.05158	43850.39781
2.021402E+08	1.243940E+13	0.00001625	0.00052788	32.48477429	1601.75456	44993.75160
2.122808E+08	1.242619E+13	0.00001708	0.00055572	32.53012437	1672.26881	47278.65630
2.223975E+08	1.241288E+13	0.00001792	0.00058365	32.57594651	1741.58621	49561.12379
2.324898E+08	1.239946E+13	0.00001875	0.00061167	32.62224466	1809.69661	51841.11772
2.425576E+08	1.238592E+13	0.00001958	0.00063977	32.66903061	1876.59000	54118.59688
2.526004E+08	1.237227E+13	0.00002042	0.00066796	32.71631223	1942.25590	56393.52123
2.626180E+08	1.235850E+13	0.00002125	0.00069624	32.76410919	2006.68416	58665.84273
2.721121E+08	1.232206E+13	0.00002208	0.00072411	32.78967565	2068.72058	60000.00000
2.795383E+08	1.219804E+13	0.00002292	0.00074996	32.72565132	2124.87068	60000.00000
2.858830E+08	1.203718E+13	0.00002375	0.00077475	32.62121004	2177.48620	60000.00000
2.913909E+08	1.185319E+13	0.00002458	0.00079869	32.48905045	2227.16671	60000.00000
2.963306E+08	1.165891E+13	0.00002542	0.00082203	32.34232360	2274.58154	60000.00000
3.007969E+08	1.145893E+13	0.00002625	0.00084487	32.18566364	2319.98265	60000.00000
3.048770E+08	1.125700E+13	0.00002708	0.00086729	32.02311462	2363.60474	60000.00000
3.086357E+08	1.105561E+13	0.00002792	0.00088936	31.85755616	2405.62971	60000.00000
3.120117E+08	1.085258E+13	0.00002875	0.00091096	31.68568772	2445.90409	60000.00000
3.151933E+08	1.065442E+13	0.00002958	0.00093235	31.51608127	2484.93178	60000.00000
3.181679E+08	1.046031E+13	0.00003042	0.00095350	31.34785169	2522.69974	60000.00000
3.208838E+08	1.026828E+13	0.00003125	0.00097431	31.17791480	2559.06830	60000.00000
3.235065E+08	1.008332E+13	0.00003208	0.00099503	31.01396137	2594.50546	60000.00000
3.258804E+08	9.900165E+12	0.00003292	0.00101541	30.84788758	2628.58566	60000.00000
3.283735E+08	9.729584E+12	0.00003375	0.00103936	30.79570431	2667.96070	60000.00000
3.305070E+08	9.556830E+12	0.00003458	0.00105898	30.62122375	2699.19589	60000.00000
3.324844E+08	9.387796E+12	0.00003542	0.00107837	30.44806498	2729.35608	60000.00000
3.344561E+08	9.226374E+12	0.00003625	0.00109779	30.28375357	2758.90365	60000.00000
3.361933E+08	9.065887E+12	0.00003708	0.00111678	30.11552793	2787.13879	60000.00000
3.378986E+08	8.911611E+12	0.00003792	0.00113576	29.95411187	2814.70462	60000.00000
3.395986E+08	8.763835E+12	0.00003875	0.00115477	29.80043381	2841.68159	60000.00000
3.410842E+08	8.616863E+12	0.00003958	0.00117336	29.64275891	2867.42591	60000.00000
3.425468E+08	8.475384E+12	0.00004042	0.00119194	29.49135464	2892.54946	60000.00000
3.440045E+08	8.339502E+12	0.00004125	0.00121055	29.34677964	2917.10627	60000.00000
3.453646E+08	8.206683E+12	0.00004208	0.00122898	29.20355004	2940.80774	60000.00000
3.466128E+08	8.076414E+12	0.00004292	0.00124719	29.06078070	2963.62760	60000.00000
3.478564E+08	7.951003E+12	0.00004375	0.00126543	28.92408925	2985.90138	60000.00000
3.490955E+08	7.830178E+12	0.00004458	0.00128369	28.79314131	3007.62660	60000.00000
3.502570E+08	7.712081E+12	0.00004542	0.00130180	28.66357809	3028.57976	60000.00000
3.506722E+08	7.582101E+12	0.00004625	0.00132275	28.59999830	3052.26388	60000.00000
3.526325E+08	7.489539E+12	0.00004708	0.00134318	28.52766949	3074.58539	60000.00000
3.536482E+08	7.380485E+12	0.00004792	0.00136049	28.39274830	3092.76550	60000.00000
3.546602E+08	7.275081E+12	0.00004875	0.00137782	28.26298445	3110.45125	60000.00000
3.555833E+08	7.171429E+12	0.00004958	0.00139492	28.13280362	3127.36882	60000.00000
3.572817E+08	6.971350E+12	0.00005125	0.00142876	27.87832314	3159.33829	60000.00000
3.589660E+08	6.783609E+12	0.00005292	0.00146271	27.64178127	3189.40607	60000.00000
3.605100E+08	6.604763E+12	0.00005458	0.00149633	27.41359109	3217.18780	60000.00000
3.619065E+08	6.433893E+12	0.00005625	0.00152958	27.19245046	3242.72053	60000.00000
3.632898E+08	6.272629E+12	0.00005792	0.00156292	26.98574334	3266.40488	60000.00000
3.646301E+08	6.119666E+12	0.00005958	0.00159626	26.79034621	3288.14756	60000.00000
3.657706E+08	5.971764E+12	0.00006125	0.00162897	26.59535033	3307.58501	60000.00000
3.668986E+08	5.831501E+12	0.00006292	0.00166177	26.41222304	3325.22083	60000.00000
3.683458E+08	5.703419E+12	0.00006458	0.00170424	26.38820261	3345.53088	60000.00000
3.693951E+08	5.575775E+12	0.00006625	0.00173585	26.20158201	3358.37736	60000.00000
3.702605E+08	5.451689E+12	0.00006792	0.00176669	26.01267189	3369.23024	60000.00000
3.711042E+08	5.333234E+12	0.00006958	0.00179757	25.83327788	3378.45625	60000.00000
3.719375E+08	5.220176E+12	0.00007125	0.00182853	25.66355735	3386.06356	60000.00000
3.727603E+08	5.112142E+12	0.00007292	0.00185958	25.50286120	3392.03686	60000.00000
3.735690E+08	5.008747E+12	0.00007458	0.00189071	25.35032791	3396.35813	60000.00000
3.742233E+08	4.907847E+12	0.00007625	0.00192109	25.19463569	3398.96330	60000.00000
3.748678E+08	4.811137E+12	0.00007792	0.00195156	25.04676408	3399.98441	60000.00000
3.754819E+08	4.718097E+12	0.00007958	0.00198212	24.90622920	3393.47093	60000.00000

3.760877E+08	4.628772E+12	0.00008125	0.00201277	24.77259833	3385.85592	60000.00000
3.766889E+08	4.542982E+12	0.00008292	0.00204352	24.64547020	3390.28101	60000.00000
3.772852E+08	4.460514E+12	0.00008458	0.00207436	24.52446717	3394.58368	60000.00000
3.777768E+08	4.380021E+12	0.00008625	0.00210460	24.40119034	3397.57963	60000.00000
3.782499E+08	4.302369E+12	0.00008792	0.00213484	24.28250831	3399.38470	60000.00000
3.782499E+08	4.222325E+12	0.00008958	0.00216792	24.19999856	3399.35998	60000.00000
3.785457E+08	4.148446E+12	0.00009125	0.00220825	24.19999856	3390.15594	60000.00000
3.799668E+08	4.089329E+12	0.00009292	0.00224281	24.13785464	3382.47763	60000.00000
3.803819E+08	4.021659E+12	0.00009458	0.00227198	24.02094680	3386.43806	60000.00000
3.807947E+08	3.956308E+12	0.00009625	0.00230122	23.90880686	3390.65692	60000.00000
3.812051E+08	3.893158E+12	0.00009792	0.00233053	23.80120665	3394.10273	60000.00000
3.815485E+08	3.831449E+12	0.00009958	0.00235927	23.69145066	3396.69455	60000.00000
3.818629E+08	3.771485E+12	0.00010125	0.00238781	23.58331937	3398.52615	60000.00000
3.821752E+08	3.713443E+12	0.00010292	0.00241642	23.47933835	3399.63052	60000.00000
3.824854E+08	3.657231E+12	0.00010458	0.00244509	23.37932271	3399.99740	60000.00000
3.827868E+08	3.602699E+12	0.00010625	0.00247398	23.28455490	3394.78418	60000.00000
3.830870E+08	3.549841E+12	0.00010792	0.00250293	23.19314665	3389.55864	60000.00000
3.833650E+08	3.498388E+12	0.00010958	0.00253235	23.10890204	3384.20618	60000.00000
3.836295E+08	3.448355E+12	0.00011125	0.00256208	23.02995247	3378.77226	60000.00000
3.838801E+08	3.399676E+12	0.00011292	0.00259213	22.95616418	3378.93161	60000.00000
3.841291E+08	3.352399E+12	0.00011458	0.00262224	22.88501555	3383.58659	60000.00000
3.843353E+08	3.306110E+12	0.00011625	0.00265216	22.81430358	3387.62034	60000.00000
3.846572E+08	3.216645E+12	0.00011958	0.00271194	22.67823368	3393.97390	60000.00000
3.849731E+08	3.131985E+12	0.00012292	0.00277195	22.55147141	3398.08523	60000.00000
3.852586E+08	3.051553E+12	0.00012625	0.00283283	22.43823391	3399.91839	60000.00000
3.855131E+08	2.975021E+12	0.00012958	0.00289462	22.33791929	3392.87606	60000.00000
3.857602E+08	2.902271E+12	0.00013292	0.00295670	22.24478406	3383.25441	60000.00000
3.860036E+08	2.833054E+12	0.00013625	0.00301896	22.15749854	3373.58622	60000.00000
3.862154E+08	2.766917E+12	0.00013958	0.00308218	22.08129877	3372.04150	60000.00000
3.863390E+08	2.703247E+12	0.00014292	0.00314428	22.00082678	3380.81542	60000.00000
3.878648E+08	2.652067E+12	0.00014625	0.00321750	22.00000066	3390.22842	60000.00000
3.893390E+08	2.602824E+12	0.00014958	0.00329083	22.00000066	3396.50984	60000.00000
3.907463E+08	2.555289E+12	0.00015292	0.00336417	22.00000066	3399.62741	60000.00000
3.918816E+08	2.508043E+12	0.00015625	0.00343750	22.00000066	3394.51569	60000.00000
3.918816E+08	2.455655E+12	0.00015958	0.00350985	21.99381262	3384.11931	60000.00000
3.918816E+08	2.405412E+12	0.00016292	0.00357301	21.93154281	3376.14802	60000.00000
3.918816E+08	2.357183E+12	0.00016625	0.00363634	21.87275058	3368.13365	60000.00000
3.918816E+08	2.310850E+12	0.00016958	0.00369984	21.81725496	3360.07514	60000.00000
3.918816E+08	2.266304E+12	0.00017292	0.00376351	21.76489466	3361.62745	60000.00000
3.918816E+08	2.223442E+12	0.00017625	0.00382736	21.71552414	3370.17444	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 385929.47495 in-kip

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Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head =   319693.000 lbs
Specified moment at pile head   =   345051000.000 in-lbs
Specified axial load at pile head   =   189766.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	3.869	3.45E+08	3.20E+05	-0.020293	1542.001	8.08E+12	0.000	0.000
4.800	3.772	3.47E+08	3.20E+05	-0.020087	1548.879	8.08E+12	0.000	0.000
9.600	3.676	3.48E+08	3.20E+05	-0.019881	1555.755	8.08E+12	0.000	0.000
14.400	3.581	3.50E+08	3.20E+05	-0.019669	1562.631	7.77E+12	0.000	0.000
19.200	3.487	3.51E+08	3.20E+05	-0.019450	1569.506	7.55E+12	0.000	0.000
24.000	3.395	3.53E+08	3.20E+05	-0.019225	1576.380	7.47E+12	0.000	0.000
28.800	3.303	3.54E+08	3.20E+05	-0.018995	1583.253	7.31E+12	0.000	0.000
33.600	3.212	3.56E+08	3.20E+05	-0.018759	1590.125	7.13E+12	0.000	0.000
38.400	3.123	3.57E+08	3.20E+05	-0.018516	1596.996	6.95E+12	0.000	0.000
43.200	3.034	3.59E+08	3.06E+05	-0.018265	1603.867	6.78E+12	-5571.532	8813.160
48.000	2.947	3.60E+08	2.79E+05	-0.018007	1610.167	6.61E+12	-5780.131	9413.199
52.800	2.862	3.62E+08	2.51E+05	-0.017742	1615.877	6.45E+12	-5978.205	10028.
57.600	2.777	3.63E+08	2.22E+05	-0.017469	1620.976	6.32E+12	-6166.067	10658.
62.400	2.694	3.64E+08	1.92E+05	-0.017191	1625.444	6.20E+12	-6344.039	11304.
67.200	2.612	3.65E+08	1.61E+05	-0.016907	1629.264	6.10E+12	-6512.443	11967.
72.000	2.532	3.65E+08	1.29E+05	-0.016617	1632.418	6.01E+12	-6671.606	12650.
76.800	2.453	3.66E+08	95805.	-0.016323	1634.891	5.94E+12	-7238.644	14167.
81.600	2.375	3.66E+08	59758.	-0.016026	1636.623	5.89E+12	-7780.912	15726.
86.400	2.299	3.67E+08	21166.	-0.015727	1637.561	5.86E+12	-8299.182	17330.
91.200	2.224	3.67E+08	-19858.	-0.015427	1637.650	5.86E+12	-8794.220	18981.
96.000	2.151	3.66E+08	-63205.	-0.015127	1636.841	5.88E+12	-9266.784	20683.

100.800	2.079	3.66E+08	-1.09E+05	-0.014830	1635.085	5.93E+12	-9717.609	22439.
105.600	2.008	3.65E+08	-1.56E+05	-0.014536	1632.336	6.01E+12	-10147.	24254.
110.400	1.939	3.65E+08	-2.06E+05	-0.014247	1628.551	6.12E+12	-10557.	26131.
115.200	1.871	3.63E+08	-2.58E+05	-0.013965	1623.687	6.25E+12	-10947.	28076.
120.000	1.805	3.62E+08	-3.11E+05	-0.013689	1617.706	6.41E+12	-11317.	30094.
124.800	1.740	3.61E+08	-3.66E+05	-0.013423	1610.568	6.60E+12	-11669.	32191.
129.600	1.676	3.59E+08	-4.23E+05	-0.013165	1602.238	6.82E+12	-12004.	34373.
134.400	1.614	3.56E+08	-4.77E+05	-0.012918	1592.683	7.06E+12	-10261.	30524.
139.200	1.552	3.54E+08	-5.25E+05	-0.012681	1582.080	7.33E+12	-9997.276	30915.
144.000	1.492	3.51E+08	-5.73E+05	-0.012453	1570.456	7.54E+12	-9736.324	31325.
148.800	1.433	3.49E+08	-6.19E+05	-0.012235	1557.837	7.88E+12	-9478.438	31756.
153.600	1.374	3.46E+08	-6.64E+05	-0.012027	1544.250	8.19E+12	-9223.410	32211.
158.400	1.317	3.42E+08	-7.07E+05	-0.011829	1529.722	8.50E+12	-8971.062	32691.
163.200	1.261	3.39E+08	-7.50E+05	-0.011641	1514.277	8.83E+12	-8721.220	33200.
168.000	1.205	3.35E+08	-7.91E+05	-0.011461	1497.941	9.17E+12	-8473.717	33741.
172.800	1.151	3.31E+08	-8.31E+05	-0.011290	1480.740	9.50E+12	-8228.392	34319.
177.600	1.097	3.27E+08	-8.70E+05	-0.011126	1462.699	9.81E+12	-7985.095	34937.
182.400	1.044	3.23E+08	-9.08E+05	-0.010969	1443.843	1.01E+13	-7743.691	35601.
187.200	0.991780	3.18E+08	-9.44E+05	-0.010820	1424.196	1.04E+13	-7548.296	36532.
192.000	0.940198	3.14E+08	-9.80E+05	-0.010676	1403.778	1.07E+13	-7479.463	38185.
196.800	0.889289	3.09E+08	-1.02E+06	-0.010539	1382.596	1.10E+13	-7399.842	39941.
201.600	0.839026	3.04E+08	-1.05E+06	-0.010407	1360.658	1.13E+13	-7309.561	41817.
206.400	0.789383	2.99E+08	-1.09E+06	-0.010280	1337.974	1.15E+13	-7208.746	43834.
211.200	0.740337	2.94E+08	-1.12E+06	-0.010158	1314.555	1.18E+13	-7097.522	46017.
216.000	0.691867	2.88E+08	-1.15E+06	-0.010040	1290.410	1.20E+13	-6976.009	48398.
220.800	0.643952	2.83E+08	-1.19E+06	-0.009926	1265.553	1.21E+13	-6844.326	51017.
225.600	0.596574	2.77E+08	-1.22E+06	-0.009816	1239.997	1.22E+13	-6702.594	53929.
230.400	0.549718	2.71E+08	-1.25E+06	-0.009709	1213.757	1.23E+13	-6551.242	57204.
235.200	0.503367	2.65E+08	-1.28E+06	-0.009605	1186.848	1.23E+13	-6441.709	61427.
240.000	0.457511	2.59E+08	-1.31E+06	-0.009503	1159.282	1.24E+13	-6324.276	66351.
244.800	0.412137	2.52E+08	-1.34E+06	-0.009404	1131.069	1.24E+13	-6199.045	72198.
249.600	0.367233	2.46E+08	-1.37E+06	-0.009307	1102.224	1.24E+13	-6066.110	79288.
254.400	0.322786	2.39E+08	-1.40E+06	-0.009213	1072.759	1.24E+13	-5925.559	88116.
259.200	0.278783	2.32E+08	-1.43E+06	-0.009122	1042.690	1.24E+13	-5777.474	99475.
264.000	0.235212	2.25E+08	-1.46E+06	-0.009034	1012.030	1.24E+13	-5621.927	1.15E+05
268.800	0.192060	2.18E+08	-1.48E+06	-0.008948	980.797	1.24E+13	-5458.984	1.36E+05
273.600	0.149313	2.11E+08	-1.51E+06	-0.008865	949.006	1.24E+13	-4549.170	1.46E+05
278.400	0.106957	2.04E+08	-1.53E+06	-0.008785	916.750	1.24E+13	-3318.419	1.49E+05
283.200	0.064979	1.97E+08	-1.54E+06	-0.008708	884.156	1.24E+13	-1178.142	87029.
288.000	0.023365	1.89E+08	-1.54E+06	-0.008633	851.441	1.25E+13	-431.817	88712.
292.800	-0.017900	1.82E+08	-1.54E+06	-0.008562	818.682	1.25E+13	337.091	90394.
297.600	-0.058828	1.74E+08	-1.54E+06	-0.008493	785.957	1.25E+13	1128.483	92077.
302.400	-0.099435	1.67E+08	-1.53E+06	-0.008428	753.346	1.25E+13	1942.277	93759.
307.200	-0.139734	1.60E+08	-1.52E+06	-0.008365	720.934	1.25E+13	2778.408	95441.
312.000	-0.179738	1.52E+08	-1.50E+06	-0.008305	688.805	1.25E+13	3636.832	97124.
316.800	-0.219461	1.45E+08	-1.48E+06	-0.008248	657.047	1.25E+13	4517.517	98806.
321.600	-0.258917	1.38E+08	-1.46E+06	-0.008193	625.749	1.25E+13	4974.331	92218.
326.400	-0.298118	1.31E+08	-1.44E+06	-0.008142	594.959	1.25E+13	5248.718	84510.
331.200	-0.337078	1.24E+08	-1.41E+06	-0.008109	564.705	3.76E+13	5496.549	78271.
336.000	-0.375962	1.18E+08	-1.38E+06	-0.008096	535.011	5.94E+13	5718.803	73013.
340.800	-0.414800	1.11E+08	-1.36E+06	-0.008087	505.900	5.95E+13	5915.686	68455.
345.600	-0.453596	1.05E+08	-1.33E+06	-0.008078	477.393	5.96E+13	6087.254	64416.
350.400	-0.492350	9.84E+07	-1.30E+06	-0.008070	449.507	5.96E+13	6233.557	60772.
355.200	-0.531067	9.22E+07	-1.27E+06	-0.008062	422.258	5.97E+13	6354.643	57436.
360.000	-0.569748	8.62E+07	-1.24E+06	-0.008055	395.656	5.97E+13	6450.554	54344.
364.800	-0.608396	8.03E+07	-1.21E+06	-0.008048	369.713	5.98E+13	6623.576	52257.
369.600	-0.647013	7.46E+07	-1.17E+06	-0.008042	344.446	5.99E+13	6798.757	50438.
374.400	-0.685601	6.91E+07	-1.14E+06	-0.008036	319.872	5.99E+13	6976.099	48841.
379.200	-0.724163	6.37E+07	-1.11E+06	-0.008031	296.010	6.00E+13	7155.608	47430.
384.000	-0.762700	5.85E+07	-1.07E+06	-0.008026	272.878	6.00E+13	7337.287	46177.
388.800	-0.801215	5.34E+07	-1.04E+06	-0.008022	250.495	6.01E+13	7521.140	45058.
393.600	-0.839709	4.85E+07	-1.00E+06	-0.008018	228.880	6.02E+13	7707.172	44056.
398.400	-0.878185	4.38E+07	-9.62E+05	-0.008014	208.051	6.02E+13	7895.386	43155.
403.200	-0.916644	3.93E+07	-9.24E+05	-0.008011	188.027	6.02E+13	8085.787	42341.
408.000	-0.955088	3.50E+07	-8.84E+05	-0.008008	168.828	6.03E+13	8453.638	42486.
412.800	-0.993518	3.08E+07	-8.42E+05	-0.008005	150.492	6.03E+13	9099.943	43965.
417.600	-1.032	2.69E+07	-7.97E+05	-0.008003	133.085	6.04E+13	9755.662	45378.
422.400	-1.070	2.32E+07	-7.49E+05	-0.008001	116.673	6.04E+13	10421.	46732.
427.200	-1.109	1.97E+07	-6.97E+05	-0.007999	101.324	6.04E+13	11095.	48034.
432.000	-1.147	1.65E+07	-6.42E+05	-0.007998	87.107	6.04E+13	11779.	49289.
436.800	-1.186	1.36E+07	-5.88E+05	-0.007996	74.093	6.04E+13	10720.	43405.
441.600	-1.224	1.09E+07	-5.35E+05	-0.007996	62.172	6.04E+13	11322.	44402.
446.400	-1.262	8.48E+06	-4.79E+05	-0.007995	51.406	6.04E+13	11937.	45393.
451.200	-1.301	6.32E+06	-4.20E+05	-0.007994	41.859	6.04E+13	12567.	46378.
456.000	-1.339	4.45E+06	-3.59E+05	-0.007994	33.594	6.04E+13	13211.	47358.
460.800	-1.377	2.89E+06	-2.94E+05	-0.007993	26.677	6.04E+13	13870.	48334.
465.600	-1.416	1.65E+06	-2.25E+05	-0.007993	21.175	6.04E+13	14543.	49306.
470.400	-1.454	7.43E+05	-1.54E+05	-0.007993	17.157	6.04E+13	15240.	50305.
475.200	-1.492	1.87E+05	-78901.	-0.007993	14.694	6.04E+13	16032.	51562.
480.000	-1.531	0.000	0.000	-0.007993	13.867	6.04E+13	16843.	26406.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     3.86907050 in
Computed slope at pile head      =    -0.02029288
Maximum bending moment           =   3.666484E+08 lbs-in
Maximum shear force              =      -1541863. lbs
Depth of maximum bending moment  =    91.20000000 in
Depth of maximum shear force     =      292.80000 in
Number of iterations             =             75
Number of zero deflection points =              1
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 3.20E+05	M= 3.45E+08	189766.	3.8691	3.6665E+08	-1541863.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

```
Shear      =         319693. lbs
Moment     =      345051000. in-lbs
Axial Load =         189766. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
480.000	3.86907050	3.666484E+08	-1541863.
456.000	4.34378502	3.667891E+08	-1626438.
432.000	4.74940328	3.657509E+08	-1700190.
408.000	5.50268193	3.656644E+08	-1821546.
384.000	6.37307755	3.644885E+08	-1940186.
360.000	7.81845595	3.643226E+08	-2095266.
336.000	10.95158618	3.640131E+08	-2323722.
312.000	18.72800809	3.643313E+08	-2700101.

The analysis ended normally.

B.3 Drained Analysis from 2.8 in. Triaxial Tests (Service)

```
================================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method

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================================================================================

This program is licensed to:

Zach McClellan
University Of Utah

--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using Triaxial Friction Angles.lpd
Name of output file:         Drilled Shaft Analysis Using Triaxial Friction Angles.lpo
Name of plot output file:    Drilled Shaft Analysis Using Triaxial Friction Angles.lpp
Name of runtime file:        Drilled Shaft Analysis Using Triaxial Friction Angles.lpr


--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:   9:54:14


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Drilled Shaft Analysis Using 2.8 in Friction Angles


--------------------------------------------------------------------------------
                                Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
```

- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 360.00 in

Depth of ground surface below top of pile = 12.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	132.00000	14902723.	13685.0000	3604997.
2	360.0000	132.00000	14902723.	13685.0000	3604997.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of moment of inertia and modulus of are not used for any computations other than total stress due to combined axial loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 8 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 12.000 in
Distance from top of pile to bottom of layer = 72.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 72.000 in
Distance from top of pile to bottom of layer = 132.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 282.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 282.000 in
Distance from top of pile to bottom of layer = 396.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 396.000 in
Distance from top of pile to bottom of layer = 462.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 6 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 462.000 in
Distance from top of pile to bottom of layer = 672.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 672.000 in
Distance from top of pile to bottom of layer = 732.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 8 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 732.000 in
Distance from top of pile to bottom of layer = 1200.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

(Depth of lowest layer extends 840.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 16 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.06900
10	462.00	0.06900
11	462.00	0.07100
12	672.00	0.07100
13	672.00	0.07200
14	732.00	0.07200
15	732.00	0.07100
16	1200.00	0.07100

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	0.00000	48.00	------	------
4	132.000	0.00000	48.00	------	------
5	132.000	0.00000	48.00	------	------
6	282.000	0.00000	48.00	------	------
7	282.000	0.00000	41.00	------	------
8	396.000	0.00000	41.00	------	------
9	396.000	0.00000	41.00	------	------
10	462.000	0.00000	41.00	------	------
11	462.000	0.00000	47.00	------	------
12	672.000	0.00000	47.00	------	------
13	672.000	0.00000	31.00	------	------
14	732.000	0.00000	31.00	------	------

```
 15      732.000        0.00000          31.00          ------    ------
 16     1200.000        0.00000          31.00          ------    ------

Notes:

(1)  Cohesion = uniaxial compressive strength for rock materials.
(2)  Values of E50 are reported for clay strata.
(3)  Default values will be generated for E50 when input values are 0.
(4)  RQD and k_rm are reported only for weak rock strata.



-------------------------------------------------------------------------------
                           p-y Modification Factors
-------------------------------------------------------------------------------

Distribution of p-y multipliers with depth defined using  4 points

Point      Depth X         p-mult         y-mult
 No.       in
-----     ----------     ----------     ----------
  1          12.000         0.0000         1.0000
  2          42.000         0.0000         1.0000
  3          42.001         1.0000         1.0000
  4        1200.000         1.0000         1.0000



-------------------------------------------------------------------------------
                                 Loading Type
-------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.



-------------------------------------------------------------------------------
              Pile-head Loading and Pile-head Fixity Conditions
-------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =      221503.000 lbs
Bending moment at pile head =   235128000.000 in-lbs
Axial load at pile head     =      117367.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head
may rotate under the applied pile-head loading, but is not a free-head
(zero moment) condition.



-------------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
-------------------------------------------------------------------------------

Number of sections =  1


Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                       =     132.0000 in

Material Properties:

Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =         100
Area of Single Bar                     =      1.27000 in**2
Number of Rows of Reinforcing Bars     =          51
Area of Steel                          =      127.000 in**2
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        0.928 percent
```

Cover Thickness (edge to bar center) = 4.000 in

Unfactored Axial Squash Load Capacity = 53716.45 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.270	62.000
2	2.540	61.878
3	2.540	61.511
4	2.540	60.902
5	2.540	60.052
6	2.540	58.966
7	2.540	57.646
8	2.540	56.099
9	2.540	54.331
10	2.540	52.348
11	2.540	50.159
12	2.540	47.772
13	2.540	45.196
14	2.540	42.442
15	2.540	39.520
16	2.540	36.443
17	2.540	33.221
18	2.540	29.869
19	2.540	26.398
20	2.540	22.824
21	2.540	19.159
22	2.540	15.419
23	2.540	11.618
24	2.540	7.771
25	2.540	3.893
26	2.540	0.000
27	2.540	-3.893
28	2.540	-7.771
29	2.540	-11.618
30	2.540	-15.419
31	2.540	-19.159
32	2.540	-22.824
33	2.540	-26.398
34	2.540	-29.869
35	2.540	-33.221
36	2.540	-36.443
37	2.540	-39.520
38	2.540	-42.442
39	2.540	-45.196
40	2.540	-47.772
41	2.540	-50.159
42	2.540	-52.348
43	2.540	-54.331
44	2.540	-56.099
45	2.540	-57.646
46	2.540	-58.966
47	2.540	-60.052
48	2.540	-60.902
49	2.540	-61.511
50	2.540	-61.878
51	1.270	-62.000

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25476354.	6.114325E+13	4.166667E-07	0.00002759	66.21587902	97.95153255	751.77520
50726322.	6.087159E+13	8.333333E-07	0.00005518	66.21542269	194.47007	1503.53938
75749906.	6.059992E+13	0.00000125	0.00008277	66.21496242	289.55565	2255.29239
1.005471E+08	6.032826E+13	0.00000167	0.00011036	66.21449822	383.20832	3007.03408
1.251179E+08	6.005660E+13	0.00000208	0.00013795	66.21403009	475.42813	3758.76432
1.251179E+08	5.004717E+13	0.00000250	0.00008208	32.83139080	282.36798	6899.72417
1.251179E+08	4.289757E+13	0.00000292	0.00009582	32.85245293	328.45176	8047.89669
1.251179E+08	3.753538E+13	0.00000333	0.00010958	32.87361342	374.25373	9195.55070
1.251179E+08	3.336478E+13	0.00000375	0.00012336	32.89486831	419.77288	10342.68307
1.251179E+08	3.002830E+13	0.00000417	0.00013715	32.91622549	465.00833	11489.28942
1.251179E+08	2.729846E+13	0.00000458	0.00015096	32.93768102	509.95903	12635.36656
1.251179E+08	2.502358E+13	0.00000500	0.00016480	32.95923489	554.62396	13780.91094

1.251179E+08	2.309869E+13	0.00000542	0.00017865	32.98088712	599.00210	14925.91898
1.251179E+08	2.144879E+13	0.00000583	0.00019250	33.00000197	643.04206	16070.83300
1.251179E+08	2.001887E+13	0.00000625	0.00020625	33.00000197	686.39668	17218.74964
1.251179E+08	1.876769E+13	0.00000667	0.00022000	33.00000197	729.40771	18366.66629
1.251179E+08	1.766371E+13	0.00000708	0.00023375	33.00000197	772.07514	19514.58293
1.251179E+08	1.668239E+13	0.00000750	0.00024755	33.00632769	814.54943	20661.12373
1.251179E+08	1.580437E+13	0.00000792	0.00026146	33.02685088	857.04776	21804.25215
1.251179E+08	1.501415E+13	0.00000833	0.00027540	33.04746455	899.24960	22946.86273
1.251179E+08	1.429919E+13	0.00000875	0.00028935	33.06817263	941.15399	24088.95119
1.253194E+08	1.367120E+13	0.00000917	0.00030332	33.08897513	982.75989	25230.51411
1.309487E+08	1.366421E+13	0.00000958	0.00031730	33.10987204	1024.06623	26371.54806
1.365720E+08	1.365720E+13	0.00001000	0.00033131	33.13086337	1065.07192	27512.04962
1.421891E+08	1.365015E+13	0.00001042	0.00034533	33.15195304	1105.77599	28652.01419
1.478001E+08	1.364308E+13	0.00001083	0.00035938	33.17314106	1146.17733	29791.43818
1.534049E+08	1.363599E+13	0.00001125	0.00037344	33.19442743	1186.27483	30930.31805
1.590035E+08	1.362887E+13	0.00001167	0.00038752	33.21581608	1226.06748	32068.64889
1.645958E+08	1.362172E+13	0.00001208	0.00040162	33.23730308	1265.55403	33206.42838
1.701818E+08	1.361454E+13	0.00001250	0.00041574	33.25889236	1304.73343	34343.65152
1.757615E+08	1.360734E+13	0.00001292	0.00042987	33.28058392	1343.60454	35480.31461
1.813348E+08	1.360011E+13	0.00001333	0.00044403	33.30237776	1382.16615	36616.41393
1.869017E+08	1.359285E+13	0.00001375	0.00045821	33.32427782	1420.41723	37751.94422
1.924622E+08	1.358556E+13	0.00001417	0.00047241	33.34628409	1458.35657	38886.90162
1.980161E+08	1.357825E+13	0.00001458	0.00048662	33.36839265	1495.98280	40021.28394
2.035636E+08	1.357091E+13	0.00001500	0.00050086	33.39061528	1533.29513	41155.08235
2.091045E+08	1.356353E+13	0.00001542	0.00051512	33.41294414	1570.29200	42288.29622
2.146388E+08	1.355613E+13	0.00001583	0.00052939	33.43538314	1606.97232	43420.91991
2.201664E+08	1.354870E+13	0.00001625	0.00054369	33.45793229	1643.33480	44552.94941
2.312016E+08	1.353375E+13	0.00001708	0.00057235	33.50336891	1715.10137	46815.20598
2.422097E+08	1.351868E+13	0.00001792	0.00060109	33.54926187	1785.58150	49075.02935
2.531904E+08	1.350349E+13	0.00001875	0.00062992	33.59562689	1854.76509	51332.37788
2.641432E+08	1.348817E+13	0.00001958	0.00065883	33.64246398	1922.64107	53587.21733
2.750680E+08	1.347272E+13	0.00002042	0.00068783	33.68978888	1989.19882	55839.50417
2.859642E+08	1.345714E+13	0.00002125	0.00071692	33.73761338	2054.42728	58089.19575
2.967232E+08	1.343652E+13	0.00002208	0.00074601	33.78144497	2118.09301	60000.00000
3.052926E+08	1.332186E+13	0.00002292	0.00077317	33.73828608	2176.02906	60000.00000
3.124730E+08	1.315676E+13	0.00002375	0.00079909	33.64578027	2229.97326	60000.00000
3.187410E+08	1.296574E+13	0.00002458	0.00082417	33.52554435	2280.95855	60000.00000
3.243247E+08	1.276031E+13	0.00002542	0.00084861	33.38796383	2329.50000	60000.00000
3.293689E+08	1.254739E+13	0.00002625	0.00087253	33.23941952	2375.93339	60000.00000
3.339510E+08	1.233050E+13	0.00002708	0.00089600	33.08319622	2420.44829	60000.00000
3.390265E+08	1.214423E+13	0.00002792	0.00092125	33.00000197	2467.36427	60000.00000
3.421665E+08	1.190144E+13	0.00002875	0.00094422	32.84229559	2508.88759	60000.00000
3.457708E+08	1.168803E+13	0.00002958	0.00096634	32.66486853	2547.92546	60000.00000
3.490333E+08	1.147507E+13	0.00003042	0.00098803	32.48322433	2585.33441	60000.00000
3.521400E+08	1.126848E+13	0.00003125	0.00100955	32.30569893	2621.60086	60000.00000
3.550246E+08	1.106570E+13	0.00003208	0.00103080	32.12880296	2656.57286	60000.00000
3.577186E+08	1.086740E+13	0.00003292	0.00105180	31.95342547	2690.33435	60000.00000
3.602788E+08	1.067493E+13	0.00003375	0.00107264	31.78199762	2723.05334	60000.00000
3.626651E+08	1.048670E+13	0.00003458	0.00109325	31.61198598	2754.62514	60000.00000
3.649275E+08	1.030384E+13	0.00003542	0.00111370	31.44555420	2785.20094	60000.00000
3.671024E+08	1.012696E+13	0.00003625	0.00113404	31.28386277	2814.87554	60000.00000
3.690935E+08	9.953084E+12	0.00003708	0.00115411	31.12201399	2843.41113	60000.00000
3.710781E+08	9.786676E+12	0.00003792	0.00117421	30.96817070	2871.28187	60000.00000
3.728888E+08	9.622938E+12	0.00003875	0.00119403	30.81374913	2898.04725	60000.00000
3.748703E+08	9.470408E+12	0.00003958	0.00121808	30.77244705	2929.84195	60000.00000
3.765709E+08	9.317218E+12	0.00004042	0.00123730	30.61348969	2954.26711	60000.00000
3.781214E+08	9.166580E+12	0.00004125	0.00125623	30.45398551	2977.67239	60000.00000
3.795985E+08	9.020163E+12	0.00004208	0.00127504	30.29793924	3000.29647	60000.00000
3.810705E+08	8.879312E+12	0.00004292	0.00129388	30.14866322	3022.33472	60000.00000
3.824793E+08	8.742383E+12	0.00004375	0.00131261	30.00261301	3043.62131	60000.00000
3.837522E+08	8.607525E+12	0.00004458	0.00133107	29.85567766	3063.96715	60000.00000
3.850203E+08	8.477511E+12	0.00004542	0.00134955	29.71478087	3083.74758	60000.00000
3.862836E+08	8.352078E+12	0.00004625	0.00136806	29.57960004	3102.95979	60000.00000
3.874732E+08	8.229519E+12	0.00004708	0.00138642	29.44603604	3121.41473	60000.00000
3.885611E+08	8.109101E+12	0.00004792	0.00140456	29.31245631	3139.05286	60000.00000
3.896445E+08	7.992708E+12	0.00004875	0.00142272	29.18403000	3156.14208	60000.00000
3.907234E+08	7.880136E+12	0.00004958	0.00144092	29.06049746	3172.67950	60000.00000
3.927391E+08	7.663203E+12	0.00005125	0.00147703	28.82004136	3203.76888	60000.00000
3.928849E+08	7.424596E+12	0.00005292	0.00151342	28.59999830	3232.79798	60000.00000
3.966872E+08	7.267552E+12	0.00005458	0.00155510	28.49045867	3263.39404	60000.00000
3.982476E+08	7.079958E+12	0.00005625	0.00158917	28.25193018	3285.88009	60000.00000
3.997207E+08	6.901653E+12	0.00005792	0.00162309	28.02449924	3306.25345	60000.00000
4.011796E+08	6.733083E+12	0.00005958	0.00165711	27.81155688	3324.68210	60000.00000
4.024870E+08	6.571216E+12	0.00006125	0.00169069	27.60316998	3340.88958	60000.00000
4.037013E+08	6.416444E+12	0.00006292	0.00172407	27.40249747	3355.04838	60000.00000
4.049021E+08	6.269452E+12	0.00006458	0.00175756	27.21378404	3367.30862	60000.00000
4.060892E+08	6.129649E+12	0.00006625	0.00179114	27.03614062	3377.65146	60000.00000
4.070893E+08	5.993952E+12	0.00006792	0.00182407	26.85745865	3385.87838	60000.00000
4.080697E+08	5.864474E+12	0.00006958	0.00185707	26.68836755	3392.23773	60000.00000
4.090370E+08	5.740870E+12	0.00007125	0.00189016	26.52863127	3396.71998	60000.00000
4.104244E+08	5.628678E+12	0.00007292	0.00192500	26.40000039	3399.38858	60000.00000

4.112162E+08	5.513513E+12	0.00007458	0.00196794	26.38583833	3395.76365	60000.00000
4.119213E+08	5.402246E+12	0.00007625	0.00199909	26.21758908	3388.01797	60000.00000
4.126212E+08	5.295674E+12	0.00007792	0.00203034	26.05779773	3390.91516	60000.00000
4.133160E+08	5.193500E+12	0.00007958	0.00206168	25.90594894	3395.12405	60000.00000
4.140054E+08	5.095451E+12	0.00008125	0.00209313	25.76156670	3398.04262	60000.00000
4.146886E+08	5.001270E+12	0.00008292	0.00212467	25.62415141	3399.65551	60000.00000
4.152413E+08	4.909256E+12	0.00008458	0.00215552	25.48392731	3398.27690	60000.00000
4.157833E+08	4.820676E+12	0.00008625	0.00218654	25.35120910	3391.53208	60000.00000
4.163220E+08	4.735417E+12	0.00008792	0.00221764	25.22439176	3384.76707	60000.00000
4.168576E+08	4.653294E+12	0.00008958	0.00224882	25.10315663	3387.41726	60000.00000
4.173898E+08	4.574134E+12	0.00009125	0.00228008	24.98720866	3391.83006	60000.00000
4.179185E+08	4.497778E+12	0.00009292	0.00231142	24.87626857	3395.30434	60000.00000
4.184053E+08	4.423668E+12	0.00009458	0.00234253	24.76681942	3397.80157	60000.00000
4.188306E+08	4.351486E+12	0.00009625	0.00237325	24.65711850	3399.34294	60000.00000
4.192528E+08	4.281731E+12	0.00009792	0.00240404	24.55194157	3399.98156	60000.00000
4.196653E+08	4.214212E+12	0.00009958	0.00243503	24.45221704	3395.38769	60000.00000
4.200742E+08	4.148881E+12	0.00010125	0.00246611	24.35663098	3389.59867	60000.00000
4.204675E+08	4.085515E+12	0.00010292	0.00249746	24.26678056	3383.73787	60000.00000
4.204675E+08	4.020407E+12	0.00010458	0.00253092	24.19999856	3379.76754	60000.00000
4.204675E+08	3.957342E+12	0.00010625	0.00257125	24.19999856	3386.74680	60000.00000
4.208985E+08	3.900217E+12	0.00010792	0.00261158	24.19999856	3392.25526	60000.00000
4.220991E+08	3.851855E+12	0.00010958	0.00264902	24.17356664	3395.93695	60000.00000
4.223088E+08	3.796034E+12	0.00011125	0.00267986	24.08860606	3397.88513	60000.00000
4.225165E+08	3.741844E+12	0.00011292	0.00271076	24.00675720	3399.20670	60000.00000
4.227224E+08	3.689214E+12	0.00011458	0.00274174	23.92789811	3399.89447	60000.00000
4.229109E+08	3.637944E+12	0.00011625	0.00277318	23.85535294	3397.83583	60000.00000
4.232583E+08	3.539442E+12	0.00011958	0.00283693	23.72342151	3387.77541	60000.00000
4.236011E+08	3.446246E+12	0.00012292	0.00290087	23.60030991	3377.66094	60000.00000
4.239317E+08	3.357875E+12	0.00012625	0.00296524	23.48701340	3376.78559	60000.00000
4.241783E+08	3.273401E+12	0.00012958	0.00302982	23.38123852	3385.30625	60000.00000
4.243690E+08	3.192745E+12	0.00013292	0.00309369	23.27543217	3391.76040	60000.00000
4.245551E+08	3.116001E+12	0.00013625	0.00315779	23.17645901	3396.38750	60000.00000
4.247363E+08	3.042887E+12	0.00013958	0.00322212	23.08387452	3399.14698	60000.00000
4.248910E+08	2.972998E+12	0.00014292	0.00328743	23.00242692	3399.29031	60000.00000
4.250180E+08	2.906106E+12	0.00014625	0.00335380	22.93198639	3390.47219	60000.00000
4.251422E+08	2.842176E+12	0.00014958	0.00342034	22.86578268	3381.61069	60000.00000
4.252636E+08	2.781015E+12	0.00015292	0.00348705	22.80356795	3372.70463	60000.00000
4.253552E+08	2.722273E+12	0.00015625	0.00355321	22.74055463	3363.94114	60000.00000
4.254075E+08	2.665739E+12	0.00015958	0.00361857	22.67509049	3367.69721	60000.00000
4.254557E+08	2.611493E+12	0.00016292	0.00368415	22.61370975	3376.02769	60000.00000
4.254777E+08	2.559265E+12	0.00016625	0.00375091	22.56188840	3383.41921	60000.00000
4.254968E+08	2.509072E+12	0.00016958	0.00381787	22.51322991	3389.49075	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 424064.41017 in-kip

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Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 221503.000 lbs
Specified moment at pile head = 235128000.000 in-lbs
Specified axial load at pile head = 117367.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	1.280	2.35E+08	2.22E+05	-0.007260	1049.893	1.35E+13	0.000	0.000
3.600	1.254	2.36E+08	2.22E+05	-0.007198	1053.438	1.35E+13	0.000	0.000
7.200	1.228	2.37E+08	2.22E+05	-0.007135	1056.983	1.35E+13	0.000	0.000
10.800	1.203	2.38E+08	2.22E+05	-0.007072	1060.527	1.35E+13	0.000	0.000
14.400	1.178	2.38E+08	2.22E+05	-0.007008	1064.072	1.35E+13	0.000	0.000
18.000	1.152	2.39E+08	2.22E+05	-0.006945	1067.617	1.35E+13	0.000	0.000
21.600	1.128	2.40E+08	2.22E+05	-0.006881	1071.161	1.35E+13	0.000	0.000
25.200	1.103	2.41E+08	2.22E+05	-0.006817	1074.705	1.35E+13	0.000	0.000
28.800	1.078	2.42E+08	2.22E+05	-0.006753	1078.250	1.35E+13	0.000	0.000
32.400	1.054	2.42E+08	2.22E+05	-0.006688	1081.794	1.35E+13	0.000	0.000
36.000	1.030	2.43E+08	2.22E+05	-0.006624	1085.338	1.35E+13	0.000	0.000
39.600	1.007	2.44E+08	2.22E+05	-0.006559	1088.881	1.35E+13	0.000	0.000
43.200	0.983120	2.45E+08	2.17E+05	-0.006494	1092.425	1.35E+13	-2750.839	10073.
46.800	0.959860	2.45E+08	2.06E+05	-0.006428	1095.811	1.35E+13	-3102.968	11638.
50.400	0.936836	2.46E+08	1.94E+05	-0.006363	1099.018	1.35E+13	-3459.309	13293.
54.000	0.914047	2.47E+08	1.81E+05	-0.006297	1102.027	1.35E+13	-3819.030	15041.
57.600	0.891496	2.48E+08	1.67E+05	-0.006231	1104.817	1.35E+13	-4181.303	16885.
61.200	0.869182	2.48E+08	1.51E+05	-0.006165	1107.366	1.35E+13	-4545.300	18826.
64.800	0.847106	2.49E+08	1.34E+05	-0.006099	1109.654	1.35E+13	-4910.199	20867.

68.400	0.825268	2.49E+08	1.16E+05	-0.006033	1111.661	1.35E+13	-5275.177	23011.
72.000	0.803670	2.49E+08	95770.	-0.005966	1113.364	1.35E+13	-5763.448	25817.
75.600	0.782310	2.50E+08	73254.	-0.005900	1114.737	1.35E+13	-6745.215	31040.
79.200	0.761191	2.50E+08	47956.	-0.005833	1115.722	1.35E+13	-7309.589	34570.
82.800	0.740311	2.50E+08	20609.	-0.005767	1116.288	1.35E+13	-7882.847	38333.
86.400	0.719671	2.50E+08	-8808.643	-0.005700	1116.401	1.35E+13	-8460.466	42322.
90.000	0.699271	2.50E+08	-40305.	-0.005633	1116.028	1.35E+13	-9037.254	46526.
93.600	0.679112	2.50E+08	-73873.	-0.005567	1115.137	1.35E+13	-9612.025	50954.
97.200	0.659191	2.50E+08	-1.10E+05	-0.005500	1113.694	1.35E+13	-10184.	55615.
100.800	0.639511	2.49E+08	-1.47E+05	-0.005434	1111.666	1.35E+13	-10751.	60520.
104.400	0.620069	2.48E+08	-1.87E+05	-0.005367	1109.021	1.35E+13	-11313.	65678.
108.000	0.600865	2.48E+08	-2.29E+05	-0.005301	1105.726	1.35E+13	-11868.	71103.
111.600	0.581900	2.47E+08	-2.72E+05	-0.005235	1101.750	1.35E+13	-12415.	76806.
115.200	0.563171	2.46E+08	-3.18E+05	-0.005170	1097.062	1.35E+13	-12785.	81727.
118.800	0.544677	2.45E+08	-3.64E+05	-0.005104	1091.640	1.35E+13	-12806.	84643.
122.400	0.526418	2.43E+08	-4.10E+05	-0.005040	1085.482	1.35E+13	-12803.	87559.
126.000	0.508393	2.42E+08	-4.56E+05	-0.004975	1078.589	1.35E+13	-12777.	90475.
129.600	0.490599	2.40E+08	-5.02E+05	-0.004911	1070.963	1.35E+13	-12727.	93391.
133.200	0.473035	2.38E+08	-5.47E+05	-0.004847	1062.607	1.35E+13	-12143.	92413.
136.800	0.455698	2.36E+08	-5.90E+05	-0.004784	1053.553	1.35E+13	-12067.	95329.
140.400	0.438588	2.34E+08	-6.33E+05	-0.004722	1043.807	1.35E+13	-11969.	98245.
144.000	0.421702	2.31E+08	-6.76E+05	-0.004660	1033.373	1.35E+13	-11850.	1.01E+05
147.600	0.405038	2.29E+08	-7.19E+05	-0.004599	1022.259	1.35E+13	-11710.	1.04E+05
151.200	0.388592	2.26E+08	-7.61E+05	-0.004538	1010.473	1.35E+13	-11549.	1.07E+05
154.800	0.372364	2.23E+08	-8.02E+05	-0.004478	998.024	1.35E+13	-11368.	1.10E+05
158.400	0.356349	2.20E+08	-8.42E+05	-0.004419	984.923	1.35E+13	-11168.	1.13E+05
162.000	0.340544	2.17E+08	-8.82E+05	-0.004361	971.180	1.36E+13	-10949.	1.16E+05
165.600	0.324948	2.14E+08	-9.21E+05	-0.004304	956.809	1.36E+13	-10710.	1.19E+05
169.200	0.309556	2.11E+08	-9.59E+05	-0.004247	941.823	1.36E+13	-10454.	1.22E+05
172.800	0.294366	2.07E+08	-9.96E+05	-0.004192	926.236	1.36E+13	-10179.	1.24E+05
176.400	0.279374	2.04E+08	-1.03E+06	-0.004138	910.066	1.36E+13	-9887.145	1.27E+05
180.000	0.264576	2.00E+08	-1.07E+06	-0.004084	893.328	1.36E+13	-9577.747	1.30E+05
183.600	0.249969	1.96E+08	-1.10E+06	-0.004032	876.040	1.36E+13	-9251.434	1.33E+05
187.200	0.235548	1.92E+08	-1.13E+06	-0.003980	858.221	1.36E+13	-8908.527	1.36E+05
190.800	0.221311	1.88E+08	-1.17E+06	-0.003930	839.890	1.36E+13	-8549.329	1.39E+05
194.400	0.207253	1.83E+08	-1.20E+06	-0.003881	821.069	1.36E+13	-8174.126	1.42E+05
198.000	0.193369	1.79E+08	-1.22E+06	-0.003833	801.779	1.36E+13	-7783.186	1.45E+05
201.600	0.179656	1.75E+08	-1.25E+06	-0.003786	782.041	1.36E+13	-7376.762	1.48E+05
205.200	0.166110	1.70E+08	-1.28E+06	-0.003740	761.880	1.36E+13	-6955.087	1.51E+05
208.800	0.152725	1.65E+08	-1.30E+06	-0.003696	741.320	1.36E+13	-6518.377	1.54E+05
212.400	0.139498	1.61E+08	-1.32E+06	-0.003653	720.386	1.36E+13	-6066.831	1.57E+05
216.000	0.126424	1.56E+08	-1.35E+06	-0.003611	699.103	1.36E+13	-5600.629	1.59E+05
219.600	0.113498	1.51E+08	-1.36E+06	-0.003571	677.499	1.36E+13	-5119.933	1.62E+05
223.200	0.100715	1.46E+08	-1.38E+06	-0.003531	655.601	1.36E+13	-4624.887	1.65E+05
226.800	0.088072	1.41E+08	-1.40E+06	-0.003494	633.438	1.37E+13	-4115.618	1.68E+05
230.400	0.075562	1.36E+08	-1.41E+06	-0.003457	611.038	1.37E+13	-3592.234	1.71E+05
234.000	0.063181	1.31E+08	-1.42E+06	-0.003422	588.432	1.37E+13	-3054.826	1.74E+05
237.600	0.050924	1.26E+08	-1.43E+06	-0.003400	565.650	4.83E+13	-2503.465	1.77E+05
241.200	0.038702	1.21E+08	-1.44E+06	-0.003392	542.725	6.01E+13	-1933.936	1.80E+05
244.800	0.026505	1.15E+08	-1.45E+06	-0.003385	519.688	6.01E+13	-1345.926	1.83E+05
248.400	0.014333	1.10E+08	-1.45E+06	-0.003378	496.575	6.02E+13	-739.440	1.86E+05
252.000	0.002185	1.05E+08	-1.45E+06	-0.003371	473.419	6.03E+13	-114.478	1.89E+05
255.600	-0.009941	9.97E+07	-1.45E+06	-0.003365	450.256	6.03E+13	528.962	1.92E+05
259.200	-0.022045	9.45E+07	-1.45E+06	-0.003359	427.124	6.04E+13	1190.889	1.94E+05
262.800	-0.034129	8.93E+07	-1.44E+06	-0.003354	404.060	6.04E+13	1871.313	1.97E+05
266.400	-0.046194	8.41E+07	-1.44E+06	-0.003349	381.104	6.05E+13	2570.247	2.00E+05
270.000	-0.058241	7.90E+07	-1.43E+06	-0.003344	358.295	6.06E+13	3287.709	2.03E+05
273.600	-0.070271	7.39E+07	-1.41E+06	-0.003339	335.675	6.06E+13	4023.718	2.06E+05
277.200	-0.082285	6.88E+07	-1.40E+06	-0.003335	313.285	6.07E+13	4778.299	2.09E+05
280.800	-0.094284	6.38E+07	-1.38E+06	-0.003331	291.170	6.07E+13	5551.477	2.12E+05
284.400	-0.106270	5.89E+07	-1.35E+06	-0.003328	269.374	6.08E+13	8154.371	2.76E+05
288.000	-0.118243	5.41E+07	-1.32E+06	-0.003324	248.045	6.08E+13	9168.884	2.79E+05
291.600	-0.130205	4.94E+07	-1.29E+06	-0.003321	227.243	6.09E+13	10202.	2.82E+05
295.200	-0.142156	4.48E+07	-1.25E+06	-0.003318	207.027	6.09E+13	11253.	2.85E+05
298.800	-0.154097	4.04E+07	-1.21E+06	-0.003316	187.456	6.09E+13	12324.	2.88E+05
302.400	-0.166030	3.61E+07	-1.16E+06	-0.003314	168.592	6.10E+13	13412.	2.91E+05
306.000	-0.177956	3.20E+07	-1.11E+06	-0.003312	150.499	6.10E+13	14520.	2.94E+05
309.600	-0.189874	2.81E+07	-1.05E+06	-0.003310	133.239	6.11E+13	15646.	2.97E+05
313.200	-0.201787	2.45E+07	-9.96E+05	-0.003308	116.877	6.11E+13	16791.	3.00E+05
316.800	-0.213694	2.10E+07	-9.34E+05	-0.003307	101.478	6.11E+13	17955.	3.02E+05
320.400	-0.225597	1.77E+07	-8.67E+05	-0.003306	87.110	6.11E+13	19138.	3.05E+05
324.000	-0.237496	1.47E+07	-7.96E+05	-0.003305	73.841	6.11E+13	20264.	3.07E+05
327.600	-0.249392	1.20E+07	-7.23E+05	-0.003304	61.734	6.11E+13	20637.	2.98E+05
331.200	-0.261286	9.54E+06	-6.48E+05	-0.003303	50.813	6.11E+13	20996.	2.89E+05
334.800	-0.273177	7.34E+06	-5.71E+05	-0.003303	41.096	6.11E+13	21340.	2.81E+05
338.400	-0.285067	5.43E+06	-4.94E+05	-0.003303	32.604	6.11E+13	21671.	2.74E+05
342.000	-0.296956	3.79E+06	-4.15E+05	-0.003302	25.356	6.11E+13	22062.	2.67E+05
345.600	-0.308844	2.44E+06	-3.35E+05	-0.003302	19.374	6.11E+13	22474.	2.62E+05
349.200	-0.320732	1.38E+06	-2.53E+05	-0.003302	14.682	6.11E+13	22879.	2.57E+05
352.800	-0.332619	6.16E+05	-1.70E+05	-0.003302	11.303	6.11E+13	23277.	2.52E+05
356.400	-0.344506	1.54E+05	-85907.	-0.003302	9.261	6.11E+13	23670.	2.47E+05

```
 360.000 -0.356393     0.000     0.000 -0.003302     8.576  6.11E+13    24056.  1.21E+05

Please note that because this analysis makes computations of ultimate moment
capacity and pile response using nonlinear bending stiffness that the above
values of total stress due to combined axial stress and bending may not be
representative of actual conditions.


Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection             =     1.28031888 in
Computed slope at pile head      =    -0.00726022
Maximum bending moment           =   2.501455E+08 lbs-in
Maximum shear force              =      -1452989. lbs
Depth of maximum bending moment  =    86.40000000 in
Depth of maximum shear force     =      252.00000 in
Number of iterations             =             36
Number of zero deflection points =              1




------------------------------------------------------------------------------
                          Summary of Pile Response(s)
------------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection   Moment      Shear
          1            2           lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  2.22E+05 M=  2.35E+08     117367.      1.2803  2.5015E+08   -1452989.

The analysis ended normally.
```

B.4 Drained Analysis from 2.8 in. Triaxial Tests (Ultimate)

```
===============================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.47)

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method

                          (c) 1985-2010 by Ensoft, Inc.
                               All Rights Reserved

===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                            Files Used for Analysis
-------------------------------------------------------------------------------
Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
```

```
Name of input data file:     Drilled Shaft Analysis Using Triaxial Friction Angles.lpd
Name of output file:         Drilled Shaft Analysis Using Triaxial Friction Angles.lpo
Name of plot output file:    Drilled Shaft Analysis Using Triaxial Friction Angles.lpp
Name of runtime file:        Drilled Shaft Analysis Using Triaxial Friction Angles.lpr


------------------------------------------------------------------------------
                          Time and Date of Analysis
------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:  10:00:24


------------------------------------------------------------------------------
                                Problem Title
------------------------------------------------------------------------------

Drilled Shaft Analysis Using 2.8 in Friction Angles


------------------------------------------------------------------------------
                                Program Options
------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments           =          100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
------------------------------------------------------------------------------

Pile Length                            =     360.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface          =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
          in            in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000   14902723.   13685.0000      3604997.
  2     360.0000     132.00000   14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.

------------------------------------------------------------------------------
```

```
                      Soil and Rock Layering Information
-------------------------------------------------------------------------------

The soil profile is modelled using  8 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       12.000 in
Distance from top of pile to bottom of layer =       72.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       72.000 in
Distance from top of pile to bottom of layer =      132.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      132.000 in
Distance from top of pile to bottom of layer =      282.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      462.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  6 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      462.000 in
Distance from top of pile to bottom of layer =      672.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      672.000 in
Distance from top of pile to bottom of layer =      732.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  8 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      732.000 in
Distance from top of pile to bottom of layer =     1200.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.


(Depth of lowest layer extends  840.00 in below pile tip)
```

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 16 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.06900
10	462.00	0.06900
11	462.00	0.07100
12	672.00	0.07100
13	672.00	0.07200
14	732.00	0.07200
15	732.00	0.07100
16	1200.00	0.07100

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	0.00000	48.00	------	------
4	132.000	0.00000	48.00	------	------
5	132.000	0.00000	48.00	------	------
6	282.000	0.00000	48.00	------	------
7	282.000	0.00000	41.00	------	------
8	396.000	0.00000	41.00	------	------
9	396.000	0.00000	41.00	------	------
10	462.000	0.00000	41.00	------	------
11	462.000	0.00000	47.00	------	------
12	672.000	0.00000	47.00	------	------
13	672.000	0.00000	31.00	------	------
14	732.000	0.00000	31.00	------	------
15	732.000	0.00000	31.00	------	------
16	1200.000	0.00000	31.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.001	1.0000	1.0000
4	1200.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 319693.000 lbs
Bending moment at pile head = 345051000.000 in-lbs
Axial load at pile head = 189766.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Number of sections = 1

Pile Section No. 1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter = 132.0000 in

Material Properties:

Compressive Strength of Concrete = 4.000 kip/in**2
Yield Stress of Reinforcement = 60. kip/in**2
Modulus of Elasticity of Reinforcement = 29000. kip/in**2
Number of Reinforcing Bars = 100
Area of Single Bar = 1.27000 in**2
Number of Rows of Reinforcing Bars = 51
Area of Steel = 127.000 in**2
Area of Shaft = 13684.778 in**2
Percentage of Steel Reinforcement = 0.928 percent
Cover Thickness (edge to bar center) = 4.000 in

Unfactored Axial Squash Load Capacity = 53716.45 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.270	62.000
2	2.540	61.878
3	2.540	61.511
4	2.540	60.902
5	2.540	60.052
6	2.540	58.966
7	2.540	57.646
8	2.540	56.099
9	2.540	54.331
10	2.540	52.348
11	2.540	50.159
12	2.540	47.772
13	2.540	45.196
14	2.540	42.442
15	2.540	39.520
16	2.540	36.443
17	2.540	33.221
18	2.540	29.869
19	2.540	26.398
20	2.540	22.824

21	2.540	19.159
22	2.540	15.419
23	2.540	11.618
24	2.540	7.771
25	2.540	3.893
26	2.540	0.000
27	2.540	-3.893
28	2.540	-7.771
29	2.540	-11.618
30	2.540	-15.419
31	2.540	-19.159
32	2.540	-22.824
33	2.540	-26.398
34	2.540	-29.869
35	2.540	-33.221
36	2.540	-36.443
37	2.540	-39.520
38	2.540	-42.442
39	2.540	-45.196
40	2.540	-47.772
41	2.540	-50.159
42	2.540	-52.348
43	2.540	-54.331
44	2.540	-56.099
45	2.540	-57.646
46	2.540	-58.966
47	2.540	-60.052
48	2.540	-60.902
49	2.540	-61.511
50	2.540	-61.878
51	1.270	-62.000

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25476354.	6.114325E+13	4.166667E-07	0.00002759	66.21587902	97.95153255	751.77520
50726322.	6.087159E+13	8.333333E-07	0.00005518	66.21542269	194.47007	1503.53938
75749906.	6.059992E+13	0.00000125	0.00008277	66.21496242	289.55565	2255.29239
1.005471E+08	6.032826E+13	0.00000167	0.00011036	66.21449822	383.20832	3007.03408
1.251179E+08	6.005660E+13	0.00000208	0.00013795	66.21403009	475.42813	3758.76432
1.251179E+08	5.004717E+13	0.00000250	0.00008208	32.83139080	282.36798	6899.72417
1.251179E+08	4.289757E+13	0.00000292	0.00009582	32.85245293	328.45176	8047.89669
1.251179E+08	3.753538E+13	0.00000333	0.00010958	32.87361342	374.25373	9195.55070
1.251179E+08	3.336478E+13	0.00000375	0.00012336	32.89486831	419.77288	10342.68307
1.251179E+08	3.002830E+13	0.00000417	0.00013715	32.91622549	465.00833	11489.28942
1.251179E+08	2.729846E+13	0.00000458	0.00015096	32.93768102	509.95903	12635.36656
1.251179E+08	2.502358E+13	0.00000500	0.00016480	32.95923489	554.62396	13780.91094
1.251179E+08	2.309869E+13	0.00000542	0.00017865	32.98088712	599.00210	14925.91898
1.251179E+08	2.144879E+13	0.00000583	0.00019250	33.00000197	643.04206	16070.83300
1.251179E+08	2.001887E+13	0.00000625	0.00020625	33.00000197	686.39668	17218.74964
1.251179E+08	1.876769E+13	0.00000667	0.00022000	33.00000197	729.40771	18366.66629
1.251179E+08	1.766371E+13	0.00000708	0.00023375	33.00000197	772.07514	19514.58293
1.251179E+08	1.668239E+13	0.00000750	0.00024755	33.00632769	814.54943	20661.12373
1.251179E+08	1.580437E+13	0.00000792	0.00026146	33.02685088	857.04776	21804.25215
1.251179E+08	1.501415E+13	0.00000833	0.00027540	33.04746455	899.24960	22946.86273
1.251179E+08	1.429919E+13	0.00000875	0.00028935	33.06817263	941.15399	24088.95119
1.253194E+08	1.367120E+13	0.00000917	0.00030332	33.08897513	982.75989	25230.51411
1.309487E+08	1.366421E+13	0.00000958	0.00031730	33.10987204	1024.06623	26371.54806
1.365720E+08	1.365720E+13	0.00001000	0.00033131	33.13086337	1065.07192	27512.04962
1.421891E+08	1.365015E+13	0.00001042	0.00034533	33.15195304	1105.77599	28652.01419
1.478001E+08	1.364308E+13	0.00001083	0.00035938	33.17314106	1146.17733	29791.43818
1.534049E+08	1.363599E+13	0.00001125	0.00037344	33.19442743	1186.27483	30930.31805
1.590035E+08	1.362887E+13	0.00001167	0.00038752	33.21581608	1226.06748	32068.64889
1.645958E+08	1.362172E+13	0.00001208	0.00040162	33.23730308	1265.55403	33206.42838
1.701818E+08	1.361454E+13	0.00001250	0.00041574	33.25889236	1304.73343	34343.65152
1.757615E+08	1.360734E+13	0.00001292	0.00042987	33.28058392	1343.60454	35480.31461
1.813348E+08	1.360011E+13	0.00001333	0.00044403	33.30237776	1382.16615	36616.41393
1.869017E+08	1.359285E+13	0.00001375	0.00045821	33.32427782	1420.41723	37751.94422
1.924622E+08	1.358556E+13	0.00001417	0.00047241	33.34628409	1458.35657	38886.90162
1.980161E+08	1.357825E+13	0.00001458	0.00048662	33.36839265	1495.98280	40021.28394
2.035636E+08	1.357091E+13	0.00001500	0.00050086	33.39061528	1533.29513	41155.08235
2.091045E+08	1.356353E+13	0.00001542	0.00051512	33.41294414	1570.29200	42288.29622
2.146388E+08	1.355613E+13	0.00001583	0.00052939	33.43538314	1606.97232	43420.91991
2.201664E+08	1.354870E+13	0.00001625	0.00054369	33.45793229	1643.33480	44552.94941
2.312016E+08	1.353375E+13	0.00001708	0.00057235	33.50336891	1715.10137	46815.20598
2.422097E+08	1.351868E+13	0.00001792	0.00060109	33.54926187	1785.58150	49075.02935
2.531904E+08	1.350349E+13	0.00001875	0.00062992	33.59562689	1854.76509	51332.37788

2.641432E+08	1.348817E+13	0.00001958	0.00065883	33.64246398	1922.64107	53587.21733
2.750680E+08	1.347272E+13	0.00002042	0.00068783	33.68978888	1989.19882	55839.50417
2.859642E+08	1.345714E+13	0.00002125	0.00071692	33.73761338	2054.42728	58089.19575
2.967232E+08	1.343652E+13	0.00002208	0.00074601	33.78144497	2118.09301	60000.00000
3.052926E+08	1.332186E+13	0.00002292	0.00077317	33.73828608	2176.02906	60000.00000
3.124730E+08	1.315676E+13	0.00002375	0.00079909	33.64578027	2229.97326	60000.00000
3.187410E+08	1.296574E+13	0.00002458	0.00082417	33.52554435	2280.95855	60000.00000
3.243247E+08	1.276031E+13	0.00002542	0.00084861	33.38796383	2329.50000	60000.00000
3.293689E+08	1.254739E+13	0.00002625	0.00087253	33.23941952	2375.93339	60000.00000
3.339510E+08	1.233050E+13	0.00002708	0.00089600	33.08319622	2420.44829	60000.00000
3.390265E+08	1.214423E+13	0.00002792	0.00092125	33.00000197	2467.36427	60000.00000
3.421665E+08	1.190144E+13	0.00002875	0.00094422	32.84229559	2508.88759	60000.00000
3.457708E+08	1.168803E+13	0.00002958	0.00096634	32.66486853	2547.92546	60000.00000
3.490333E+08	1.147507E+13	0.00003042	0.00098803	32.48322433	2585.33441	60000.00000
3.521400E+08	1.126848E+13	0.00003125	0.00100955	32.30569893	2621.60086	60000.00000
3.550246E+08	1.106570E+13	0.00003208	0.00103080	32.12880296	2656.57286	60000.00000
3.577186E+08	1.086740E+13	0.00003292	0.00105180	31.95342547	2690.33435	60000.00000
3.602788E+08	1.067493E+13	0.00003375	0.00107264	31.78199762	2723.05334	60000.00000
3.626651E+08	1.048670E+13	0.00003458	0.00109325	31.61198598	2754.62514	60000.00000
3.649275E+08	1.030384E+13	0.00003542	0.00111370	31.44555420	2785.20094	60000.00000
3.671024E+08	1.012696E+13	0.00003625	0.00113404	31.28386277	2814.87554	60000.00000
3.690935E+08	9.953084E+12	0.00003708	0.00115411	31.12201399	2843.41113	60000.00000
3.710781E+08	9.786676E+12	0.00003792	0.00117421	30.96817070	2871.28187	60000.00000
3.728888E+08	9.622938E+12	0.00003875	0.00119403	30.81374913	2898.04725	60000.00000
3.748703E+08	9.470408E+12	0.00003958	0.00121808	30.77244705	2929.84195	60000.00000
3.765709E+08	9.317218E+12	0.00004042	0.00123730	30.61348969	2954.26711	60000.00000
3.781214E+08	9.166580E+12	0.00004125	0.00125623	30.45398551	2977.67239	60000.00000
3.795985E+08	9.020163E+12	0.00004208	0.00127504	30.29793924	3000.29647	60000.00000
3.810705E+08	8.879312E+12	0.00004292	0.00129388	30.14866322	3022.33472	60000.00000
3.824793E+08	8.742383E+12	0.00004375	0.00131261	30.00261301	3043.62131	60000.00000
3.837522E+08	8.607525E+12	0.00004458	0.00133107	29.85567766	3063.96715	60000.00000
3.850203E+08	8.477511E+12	0.00004542	0.00134955	29.71478087	3083.74758	60000.00000
3.862836E+08	8.352078E+12	0.00004625	0.00136806	29.57960004	3102.95979	60000.00000
3.874732E+08	8.229519E+12	0.00004708	0.00138642	29.44603604	3121.41473	60000.00000
3.885611E+08	8.109101E+12	0.00004792	0.00140456	29.31245631	3139.05286	60000.00000
3.896445E+08	7.992708E+12	0.00004875	0.00142272	29.18403000	3156.14208	60000.00000
3.907234E+08	7.880136E+12	0.00004958	0.00144092	29.06049746	3172.67950	60000.00000
3.927391E+08	7.663203E+12	0.00005125	0.00147703	28.82004136	3203.76888	60000.00000
3.928849E+08	7.424596E+12	0.00005292	0.00151342	28.59999830	3232.79798	60000.00000
3.966872E+08	7.267552E+12	0.00005458	0.00155510	28.49045867	3263.39404	60000.00000
3.982476E+08	7.079958E+12	0.00005625	0.00158917	28.25193018	3285.88009	60000.00000
3.997207E+08	6.901653E+12	0.00005792	0.00162309	28.02449924	3306.25345	60000.00000
4.011796E+08	6.733083E+12	0.00005958	0.00165711	27.81155688	3324.68210	60000.00000
4.024870E+08	6.571216E+12	0.00006125	0.00169069	27.60316998	3340.88958	60000.00000
4.037013E+08	6.416444E+12	0.00006292	0.00172407	27.40249747	3355.04838	60000.00000
4.049021E+08	6.269452E+12	0.00006458	0.00175756	27.21378404	3367.30862	60000.00000
4.060892E+08	6.129649E+12	0.00006625	0.00179114	27.03614062	3377.65146	60000.00000
4.070893E+08	5.993952E+12	0.00006792	0.00182407	26.85745865	3385.87838	60000.00000
4.080697E+08	5.864474E+12	0.00006958	0.00185707	26.68836755	3392.23773	60000.00000
4.090370E+08	5.740870E+12	0.00007125	0.00189016	26.52863127	3396.71998	60000.00000
4.104244E+08	5.628678E+12	0.00007292	0.00192500	26.40000039	3399.38858	60000.00000
4.112162E+08	5.513513E+12	0.00007458	0.00196794	26.38583833	3395.76365	60000.00000
4.119213E+08	5.402246E+12	0.00007625	0.00199909	26.21758908	3388.01797	60000.00000
4.126212E+08	5.295674E+12	0.00007792	0.00203034	26.05779773	3390.91516	60000.00000
4.133160E+08	5.193500E+12	0.00007958	0.00206168	25.90594894	3395.12405	60000.00000
4.140054E+08	5.095451E+12	0.00008125	0.00209313	25.76156670	3398.04262	60000.00000
4.146886E+08	5.001270E+12	0.00008292	0.00212467	25.62415141	3399.65551	60000.00000
4.152413E+08	4.909256E+12	0.00008458	0.00215552	25.48392731	3398.27690	60000.00000
4.157833E+08	4.820676E+12	0.00008625	0.00218654	25.35120910	3391.53208	60000.00000
4.163220E+08	4.735417E+12	0.00008792	0.00221764	25.22439176	3384.76707	60000.00000
4.168576E+08	4.653294E+12	0.00008958	0.00224882	25.10315663	3387.41726	60000.00000
4.173898E+08	4.574134E+12	0.00009125	0.00228008	24.98720866	3391.83006	60000.00000
4.179185E+08	4.497778E+12	0.00009292	0.00231142	24.87626857	3395.30434	60000.00000
4.184053E+08	4.423668E+12	0.00009458	0.00234253	24.76681942	3397.80157	60000.00000
4.188306E+08	4.351486E+12	0.00009625	0.00237325	24.65711850	3399.34294	60000.00000
4.192528E+08	4.281731E+12	0.00009792	0.00240404	24.55194157	3399.98156	60000.00000
4.196653E+08	4.214212E+12	0.00009958	0.00243503	24.45221704	3395.38769	60000.00000
4.200742E+08	4.148881E+12	0.00010125	0.00246611	24.35663098	3389.59867	60000.00000
4.204675E+08	4.085515E+12	0.00010292	0.00249746	24.26678056	3383.73787	60000.00000
4.204675E+08	4.020407E+12	0.00010458	0.00253092	24.19999856	3379.76754	60000.00000
4.204675E+08	3.957342E+12	0.00010625	0.00257125	24.19999856	3386.74680	60000.00000
4.208985E+08	3.900217E+12	0.00010792	0.00261158	24.19999856	3392.25526	60000.00000
4.220991E+08	3.851855E+12	0.00010958	0.00264902	24.17356664	3395.93695	60000.00000
4.223088E+08	3.796034E+12	0.00011125	0.00267986	24.08860606	3397.88513	60000.00000
4.225165E+08	3.741844E+12	0.00011292	0.00271076	24.00675720	3399.20670	60000.00000
4.227224E+08	3.689214E+12	0.00011458	0.00274174	23.92789811	3399.89447	60000.00000
4.229109E+08	3.637944E+12	0.00011625	0.00277318	23.85535294	3397.83583	60000.00000
4.232583E+08	3.539442E+12	0.00011958	0.00283693	23.72342151	3387.77541	60000.00000
4.236011E+08	3.446246E+12	0.00012292	0.00290087	23.60030991	3377.66094	60000.00000
4.239317E+08	3.357875E+12	0.00012625	0.00296524	23.48701340	3376.78559	60000.00000
4.241783E+08	3.273401E+12	0.00012958	0.00302982	23.38123852	3385.30625	60000.00000

4.243690E+08	3.192745E+12	0.00013292	0.00309369	23.27543217	3391.76040	60000.00000
4.245551E+08	3.116001E+12	0.00013625	0.00315779	23.17645901	3396.38750	60000.00000
4.247363E+08	3.042887E+12	0.00013958	0.00322212	23.08387452	3399.14698	60000.00000
4.248910E+08	2.972998E+12	0.00014292	0.00328743	23.00242692	3399.29031	60000.00000
4.250180E+08	2.906106E+12	0.00014625	0.00335380	22.93198639	3390.47219	60000.00000
4.251422E+08	2.842176E+12	0.00014958	0.00342034	22.86578268	3381.61069	60000.00000
4.252636E+08	2.781015E+12	0.00015292	0.00348705	22.80356795	3372.70463	60000.00000
4.253552E+08	2.722273E+12	0.00015625	0.00355321	22.74055463	3363.94114	60000.00000
4.254075E+08	2.665739E+12	0.00015958	0.00361857	22.67509049	3367.69721	60000.00000
4.254557E+08	2.611493E+12	0.00016292	0.00368415	22.61370975	3376.02769	60000.00000
4.254777E+08	2.559265E+12	0.00016625	0.00375091	22.56188840	3383.41921	60000.00000
4.254968E+08	2.509072E+12	0.00016958	0.00381787	22.51322991	3389.49075	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 424064.41017 in-kip

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Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 319693.000 lbs
Specified moment at pile head = 345051000.000 in-lbs
Specified axial load at pile head = 189766.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	2.529	3.45E+08	3.20E+05	-0.014123	1542.001	1.17E+13	0.000	0.000
3.600	2.478	3.46E+08	3.20E+05	-0.014016	1547.141	1.17E+13	0.000	0.000
7.200	2.428	3.47E+08	3.20E+05	-0.013909	1552.280	1.17E+13	0.000	0.000
10.800	2.378	3.49E+08	3.20E+05	-0.013801	1557.419	1.15E+13	0.000	0.000
14.400	2.329	3.50E+08	3.20E+05	-0.013691	1562.558	1.14E+13	0.000	0.000
18.000	2.279	3.51E+08	3.20E+05	-0.013580	1567.696	1.14E+13	0.000	0.000
21.600	2.231	3.52E+08	3.20E+05	-0.013469	1572.834	1.13E+13	0.000	0.000
25.200	2.182	3.53E+08	3.20E+05	-0.013356	1577.971	1.12E+13	0.000	0.000
28.800	2.135	3.54E+08	3.20E+05	-0.013242	1583.109	1.11E+13	0.000	0.000
32.400	2.087	3.55E+08	3.20E+05	-0.013126	1588.245	1.10E+13	0.000	0.000
36.000	2.040	3.57E+08	3.20E+05	-0.013009	1593.382	1.09E+13	0.000	0.000
39.600	1.993	3.58E+08	3.20E+05	-0.012891	1598.518	1.09E+13	0.000	0.000
43.200	1.947	3.59E+08	3.14E+05	-0.012772	1603.654	1.08E+13	-3306.766	6113.313
46.800	1.902	3.60E+08	3.01E+05	-0.012652	1608.600	1.07E+13	-3733.846	7069.000
50.400	1.856	3.61E+08	2.87E+05	-0.012530	1613.331	1.06E+13	-4166.925	8081.559
54.000	1.811	3.62E+08	2.71E+05	-0.012406	1617.822	1.05E+13	-4605.041	9152.591
57.600	1.767	3.63E+08	2.54E+05	-0.012282	1622.049	1.04E+13	-5047.233	10284.
61.200	1.723	3.64E+08	2.35E+05	-0.012156	1625.985	1.04E+13	-5492.539	11477.
64.800	1.679	3.65E+08	2.14E+05	-0.012029	1629.607	1.03E+13	-5939.999	12734.
68.400	1.636	3.66E+08	1.92E+05	-0.011901	1632.886	1.03E+13	-6388.654	14056.
72.000	1.594	3.66E+08	1.68E+05	-0.011773	1635.799	1.02E+13	-6982.996	15774.
75.600	1.552	3.67E+08	1.41E+05	-0.011643	1638.310	1.02E+13	-8181.866	18985.
79.200	1.510	3.67E+08	1.10E+05	-0.011513	1640.352	1.01E+13	-8876.792	21166.
82.800	1.469	3.68E+08	76649.	-0.011382	1641.883	1.01E+13	-9579.199	23481.
86.400	1.428	3.68E+08	40892.	-0.011250	1642.865	1.01E+13	-10285.	25932.
90.000	1.388	3.68E+08	2593.914	-0.011118	1643.255	1.01E+13	-10991.	28516.
93.600	1.348	3.68E+08	-38243.	-0.010987	1643.015	1.01E+13	-11696.	31239.
97.200	1.309	3.68E+08	-81610.	-0.010855	1642.102	1.01E+13	-12397.	34106.
100.800	1.270	3.67E+08	-1.27E+05	-0.010724	1640.478	1.01E+13	-13093.	37125.
104.400	1.231	3.67E+08	-1.76E+05	-0.010594	1638.102	1.02E+13	-13784.	40301.
108.000	1.193	3.66E+08	-2.27E+05	-0.010464	1634.934	1.02E+13	-14467.	43642.
111.600	1.156	3.65E+08	-2.80E+05	-0.010336	1630.936	1.03E+13	-15142.	47157.
115.200	1.119	3.64E+08	-3.36E+05	-0.010209	1626.068	1.04E+13	-15806.	50853.
118.800	1.082	3.63E+08	-3.94E+05	-0.010083	1620.292	1.05E+13	-16459.	54740.
122.400	1.046	3.61E+08	-4.54E+05	-0.009960	1613.572	1.06E+13	-17099.	58829.
126.000	1.011	3.59E+08	-5.17E+05	-0.009838	1605.869	1.07E+13	-17725.	63132.
129.600	0.975533	3.58E+08	-5.82E+05	-0.009719	1597.149	1.09E+13	-18335.	67660.
133.200	0.940758	3.55E+08	-6.47E+05	-0.009602	1587.377	1.10E+13	-17978.	68795.
136.800	0.906400	3.53E+08	-7.13E+05	-0.009487	1576.572	1.12E+13	-18506.	73502.
140.400	0.872450	3.50E+08	-7.80E+05	-0.009375	1564.704	1.14E+13	-19016.	78468.
144.000	0.838898	3.47E+08	-8.50E+05	-0.009266	1551.745	1.16E+13	-19507.	83710.
147.600	0.805734	3.44E+08	-9.21E+05	-0.009160	1537.665	1.18E+13	-19976.	89250.
151.200	0.772949	3.41E+08	-9.93E+05	-0.009056	1522.439	1.20E+13	-20422.	95115.
154.800	0.740531	3.37E+08	-1.07E+06	-0.008955	1506.041	1.22E+13	-20863.	1.01E+05
158.400	0.708470	3.33E+08	-1.14E+06	-0.008857	1488.444	1.24E+13	-21280.	1.08E+05
162.000	0.676758	3.29E+08	-1.22E+06	-0.008762	1469.626	1.26E+13	-21670.	1.15E+05
165.600	0.645385	3.24E+08	-1.30E+06	-0.008669	1449.564	1.28E+13	-21272.	1.19E+05
169.200	0.614340	3.19E+08	-1.37E+06	-0.008579	1428.281	1.29E+13	-20747.	1.22E+05
172.800	0.583616	3.14E+08	-1.45E+06	-0.008491	1405.807	1.31E+13	-20182.	1.24E+05

176.400	0.553203	3.09E+08	-1.52E+06	-0.008406	1382.174	1.32E+13	-19578.	1.27E+05
180.000	0.523092	3.03E+08	-1.59E+06	-0.008323	1357.417	1.33E+13	-18936.	1.30E+05
183.600	0.493275	2.98E+08	-1.66E+06	-0.008242	1331.573	1.34E+13	-18256.	1.33E+05
187.200	0.463746	2.91E+08	-1.72E+06	-0.008164	1304.681	1.34E+13	-17539.	1.36E+05
190.800	0.434498	2.85E+08	-1.78E+06	-0.008086	1276.782	1.35E+13	-16785.	1.39E+05
194.400	0.405525	2.79E+08	-1.84E+06	-0.008011	1247.920	1.35E+13	-15994.	1.42E+05
198.000	0.376819	2.72E+08	-1.90E+06	-0.007937	1218.139	1.35E+13	-15167.	1.45E+05
201.600	0.348375	2.65E+08	-1.95E+06	-0.007866	1187.487	1.35E+13	-14304.	1.48E+05
205.200	0.320186	2.58E+08	-2.00E+06	-0.007796	1156.014	1.35E+13	-13406.	1.51E+05
208.800	0.292244	2.51E+08	-2.05E+06	-0.007728	1123.772	1.35E+13	-12473.	1.54E+05
212.400	0.264543	2.43E+08	-2.09E+06	-0.007662	1090.813	1.35E+13	-11505.	1.57E+05
216.000	0.237075	2.36E+08	-2.13E+06	-0.007599	1057.194	1.35E+13	-10503.	1.59E+05
219.600	0.209833	2.28E+08	-2.16E+06	-0.007537	1022.972	1.35E+13	-9465.639	1.62E+05
223.200	0.182809	2.20E+08	-2.20E+06	-0.007477	988.207	1.35E+13	-8394.642	1.65E+05
226.800	0.155995	2.12E+08	-2.23E+06	-0.007420	952.959	1.36E+13	-7289.699	1.68E+05
230.400	0.129384	2.04E+08	-2.25E+06	-0.007365	917.293	1.36E+13	-6150.954	1.71E+05
234.000	0.102967	1.96E+08	-2.27E+06	-0.007312	881.273	1.36E+13	-4978.518	1.74E+05
237.600	0.076738	1.88E+08	-2.29E+06	-0.007261	844.968	1.36E+13	-3772.476	1.77E+05
241.200	0.050688	1.79E+08	-2.30E+06	-0.007212	808.446	1.36E+13	-2532.884	1.80E+05
244.800	0.024808	1.71E+08	-2.30E+06	-0.007166	771.779	1.36E+13	-1259.771	1.83E+05
248.400	-0.000908	1.63E+08	-2.31E+06	-0.007122	735.039	1.36E+13	46.862	1.86E+05
252.000	-0.026470	1.55E+08	-2.30E+06	-0.007080	698.301	1.36E+13	1387.038	1.89E+05
255.600	-0.051885	1.46E+08	-2.30E+06	-0.007040	661.644	1.36E+13	2760.808	1.92E+05
259.200	-0.077161	1.38E+08	-2.28E+06	-0.007003	625.144	1.37E+13	4168.245	1.94E+05
262.800	-0.102305	1.30E+08	-2.27E+06	-0.006968	588.884	1.37E+13	5609.446	1.97E+05
266.400	-0.127327	1.22E+08	-2.24E+06	-0.006947	552.945	6.01E+13	7084.531	2.00E+05
270.000	-0.152323	1.14E+08	-2.21E+06	-0.006940	517.413	6.02E+13	8598.668	2.03E+05
273.600	-0.177294	1.06E+08	-2.18E+06	-0.006933	482.375	6.03E+13	10152.	2.06E+05
277.200	-0.202242	9.80E+07	-2.14E+06	-0.006927	447.919	6.03E+13	11744.	2.09E+05
280.800	-0.227169	9.04E+07	-2.10E+06	-0.006922	414.137	6.04E+13	13376.	2.12E+05
284.400	-0.252077	8.29E+07	-2.04E+06	-0.006916	381.123	6.05E+13	19343.	2.76E+05
288.000	-0.276967	7.57E+07	-1.96E+06	-0.006912	349.219	6.06E+13	21025.	2.73E+05
291.600	-0.301840	6.88E+07	-1.89E+06	-0.006907	318.522	6.07E+13	21765.	2.60E+05
295.200	-0.326700	6.21E+07	-1.81E+06	-0.006903	289.074	6.07E+13	22477.	2.48E+05
298.800	-0.351545	5.58E+07	-1.73E+06	-0.006900	260.917	6.08E+13	23163.	2.37E+05
302.400	-0.376379	4.97E+07	-1.64E+06	-0.006897	234.088	6.09E+13	23827.	2.28E+05
306.000	-0.401203	4.40E+07	-1.55E+06	-0.006894	208.627	6.09E+13	24469.	2.20E+05
309.600	-0.426017	3.85E+07	-1.47E+06	-0.006892	184.571	6.10E+13	25093.	2.12E+05
313.200	-0.450823	3.34E+07	-1.37E+06	-0.006890	161.955	6.10E+13	25698.	2.05E+05
316.800	-0.475621	2.87E+07	-1.28E+06	-0.006888	140.814	6.11E+13	26287.	1.99E+05
320.400	-0.500414	2.42E+07	-1.18E+06	-0.006886	121.181	6.11E+13	26859.	1.93E+05
324.000	-0.525202	2.01E+07	-1.09E+06	-0.006885	103.091	6.11E+13	27416.	1.88E+05
327.600	-0.549985	1.64E+07	-9.87E+05	-0.006884	86.573	6.11E+13	27959.	1.83E+05
331.200	-0.574764	1.30E+07	-8.85E+05	-0.006883	71.661	6.11E+13	28487.	1.78E+05
334.800	-0.599541	1.01E+07	-7.82E+05	-0.006882	58.383	6.11E+13	29001.	1.74E+05
338.400	-0.624316	7.43E+06	-6.77E+05	-0.006882	46.770	6.11E+13	29501.	1.70E+05
342.000	-0.649090	5.19E+06	-5.69E+05	-0.006881	36.851	6.11E+13	30090.	1.67E+05
345.600	-0.673862	3.34E+06	-4.60E+05	-0.006881	28.658	6.11E+13	30710.	1.64E+05
349.200	-0.698633	1.89E+06	-3.48E+05	-0.006881	22.228	6.11E+13	31327.	1.61E+05
352.800	-0.723404	8.42E+05	-2.34E+05	-0.006881	17.596	6.11E+13	31939.	1.59E+05
356.400	-0.748175	2.10E+05	-1.18E+05	-0.006881	14.797	6.11E+13	32548.	1.57E+05
360.000	-0.772946	0.000	0.000	-0.006881	13.867	6.11E+13	33154.	77207.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection            =     2.52883240 in
Computed slope at pile head     =    -0.01412274
Maximum bending moment          =   3.679141E+08 lbs-in
Maximum shear force             =      -2305669. lbs
Depth of maximum bending moment =    90.00000000 in
Depth of maximum shear force    =      248.40000 in
Number of iterations            =             44
Number of zero deflection points =             1
```

Summary of Pile Response(s)

```
--------------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2            lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  3.20E+05 M=  3.45E+08     189766.      2.5288  3.6791E+08   -2305669.

The analysis ended normally.
```

B.5 Drained Analysis from 6.0 in. Triaxial Tests (Service)

```
================================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method

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                             All Rights Reserved

================================================================================

This program is licensed to:

Zach McClellan
University Of Utah

--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using 6 inch Triax Friction Angles.lpd
Name of output file:         Drilled Shaft Analysis Using 6 inch Triax Friction Angles.lpo
Name of plot output file:    Drilled Shaft Analysis Using 6 inch Triax Friction Angles.lpp
Name of runtime file:        Drilled Shaft Analysis Using 6 inch Triax Friction Angles.lpr

--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:  13:20:58

--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Drilled Shaft Analysis Using 6 in Friction Angles

--------------------------------------------------------------------------------
                                Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
```

- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 480.00 in

Depth of ground surface below top of pile = 12.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	132.00000	14902723.	13685.0000	3604997.
2	480.0000	132.00000	14902723.	13685.0000	3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 8 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 12.000 in
Distance from top of pile to bottom of layer = 72.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 72.000 in
Distance from top of pile to bottom of layer = 132.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 282.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

```
NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      462.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  6 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      462.000 in
Distance from top of pile to bottom of layer =      672.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      672.000 in
Distance from top of pile to bottom of layer =      732.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  8 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      732.000 in
Distance from top of pile to bottom of layer =     1200.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.


(Depth of lowest layer extends  720.00 in below pile tip)


-------------------------------------------------------------------------------
                   Effective Unit Weight of Soil vs. Depth
-------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 16 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           12.00        0.05300
  2           72.00        0.05300
  3           72.00        0.07300
  4          132.00        0.07300
  5          132.00        0.06700
  6          282.00        0.06700
  7          282.00        0.07000
  8          396.00        0.07000
  9          396.00        0.06900
 10          462.00        0.06900
 11          462.00        0.07100
 12          672.00        0.07100
 13          672.00        0.07200
 14          732.00        0.07200
 15          732.00        0.07100
 16         1200.00        0.07100


-------------------------------------------------------------------------------
```

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	0.00000	24.00	------	------
4	132.000	0.00000	24.00	------	------
5	132.000	0.00000	25.00	------	------
6	282.000	0.00000	25.00	------	------
7	282.000	0.00000	39.00	------	------
8	396.000	0.00000	39.00	------	------
9	396.000	0.00000	39.00	------	------
10	462.000	0.00000	39.00	------	------
11	462.000	0.00000	48.00	------	------
12	672.000	0.00000	48.00	------	------
13	672.000	0.00000	39.00	------	------
14	732.000	0.00000	39.00	------	------
15	732.000	0.00000	48.00	------	------
16	1200.000	0.00000	48.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.001	1.0000	1.0000
4	1200.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 221503.000 lbs
Bending moment at pile head = 235128000.000 in-lbs
Axial load at pile head = 117367.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Output of p-y Curves at Specified Depths

```
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p-y curves are generated and printed for verification at  3 depths.

Depth      Depth Below Pile Head      Depth Below Ground Surface
 No.                in                           in
-----      ---------------------      --------------------------
  1               60.000                       48.000
  2              174.000                      162.000
  3              348.000                      336.000

Depth of ground surface below top of pile =      12.00 in



-------------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
-------------------------------------------------------------------------------

Number of sections =  1



Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                       =     132.0000 in

Material Properties:

Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =          90
Area of Single Bar                     =      1.27000 in**2
Number of Rows of Reinforcing Bars     =          45
Area of Steel                          =      114.300 in**2
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        0.835 percent
Cover Thickness (edge to bar center)   =        4.000 in

Unfactored Axial Squash Load Capacity  =     52997.63 kip

Distribution and Area of Steel Reinforcement

 Row         Area of        Distance to
Number     Reinforcement   Centroidal Axis
              in**2              in
------     -------------   ---------------
   1           2.540            61.962
   2           2.540            61.660
   3           2.540            61.058
   4           2.540            60.158
   5           2.540            58.966
   6           2.540            57.485
   7           2.540            55.725
   8           2.540            53.694
   9           2.540            51.400
  10           2.540            48.857
  11           2.540            46.075
  12           2.540            43.069
  13           2.540            39.853
  14           2.540            36.443
  15           2.540            32.855
  16           2.540            29.107
  17           2.540            25.218
  18           2.540            21.205
  19           2.540            17.090
  20           2.540            12.891
  21           2.540             8.629
  22           2.540             4.325
  23           2.540             0.000
  24           2.540            -4.325
  25           2.540            -8.629
  26           2.540           -12.891
  27           2.540           -17.090
  28           2.540           -21.205
  29           2.540           -25.218
```

30	2.540	-29.107
31	2.540	-32.855
32	2.540	-36.443
33	2.540	-39.853
34	2.540	-43.069
35	2.540	-46.075
36	2.540	-48.857
37	2.540	-51.400
38	2.540	-53.694
39	2.540	-55.725
40	2.540	-57.485
41	2.540	-58.966
42	2.540	-60.158
43	2.540	-61.058
44	2.540	-61.660
45	2.540	-61.962

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25181408.	6.043538E+13	4.166667E-07	0.00002759	66.21742111	97.95383531	751.33747
50136430.	6.016372E+13	8.333333E-07	0.00005518	66.21697265	194.47463	1502.66409
74865067.	5.989205E+13	0.00000125	0.00008277	66.21652025	289.56242	2253.97974
99367320.	5.962039E+13	0.00000167	0.00011036	66.21605998	383.21724	3005.28408
1.236432E+08	5.934873E+13	0.00000208	0.00013795	66.21559578	475.43913	3756.57705
1.236432E+08	4.945727E+13	0.00000250	0.00007949	31.79650587	273.35193	6972.01509
1.236432E+08	4.239195E+13	0.00000292	0.00009280	31.81586856	317.99257	8132.37985
1.236432E+08	3.709296E+13	0.00000333	0.00010612	31.83531779	362.36870	9292.26830
1.236432E+08	3.297152E+13	0.00000375	0.00011946	31.85484964	406.47939	10451.67775
1.236432E+08	2.967436E+13	0.00000417	0.00013281	31.87446803	450.32382	11610.60473
1.236432E+08	2.697670E+13	0.00000458	0.00014618	31.89417690	493.90115	12769.04556
1.236432E+08	2.472864E+13	0.00000500	0.00015957	31.91396838	537.21037	13926.99812
1.236432E+08	2.282643E+13	0.00000542	0.00017298	31.93385428	580.25077	15084.45755
1.236432E+08	2.119597E+13	0.00000583	0.00018640	31.95382673	623.02128	16241.42177
1.236432E+08	1.978291E+13	0.00000625	0.00019984	31.97388965	665.52107	17397.88692
1.236432E+08	1.854648E+13	0.00000667	0.00021329	31.99404305	707.74918	18553.84972
1.236432E+08	1.745551E+13	0.00000708	0.00022677	32.01428694	749.70467	19709.30690
1.236432E+08	1.648576E+13	0.00000750	0.00024026	32.03462523	791.38666	20864.25431
1.236432E+08	1.561809E+13	0.00000792	0.00025377	32.05505794	832.79420	22018.68854
1.236432E+08	1.483718E+13	0.00000833	0.00026730	32.07558507	873.92631	23172.60617
1.236432E+08	1.413065E+13	0.00000875	0.00028084	32.09620661	914.78199	24326.00376
1.236432E+08	1.348835E+13	0.00000917	0.00029441	32.11692256	955.36025	25478.87790
1.236432E+08	1.290190E+13	0.00000958	0.00030799	32.13773686	995.66017	26631.22407
1.253513E+08	1.253513E+13	0.00001000	0.00032159	32.15864950	1035.68073	27783.03871
1.305096E+08	1.252892E+13	0.00001042	0.00033520	32.17966443	1075.42102	28934.31707
1.356625E+08	1.252269E+13	0.00001083	0.00034884	32.20077378	1114.87976	30085.05790
1.408098E+08	1.251643E+13	0.00001125	0.00036250	32.22198540	1154.05612	31235.25522
1.459517E+08	1.251015E+13	0.00001167	0.00037617	32.24330324	1192.94917	32384.90399
1.510881E+08	1.250384E+13	0.00001208	0.00038987	32.26471943	1231.55756	33534.00311
1.562189E+08	1.249751E+13	0.00001250	0.00040358	32.28624183	1269.88047	34682.54617
1.613441E+08	1.249116E+13	0.00001292	0.00041731	32.30786651	1307.91664	35830.53080
1.664637E+08	1.248477E+13	0.00001333	0.00043106	32.32959741	1345.66510	36977.95176
1.715776E+08	1.247837E+13	0.00001375	0.00044483	32.35143453	1383.12470	38124.80520
1.766858E+08	1.247194E+13	0.00001417	0.00045862	32.37338179	1420.29446	39271.08566
1.817883E+08	1.246548E+13	0.00001458	0.00047243	32.39543921	1457.17321	40416.78915
1.868850E+08	1.245900E+13	0.00001500	0.00048626	32.41760284	1493.75962	41561.91337
1.919759E+08	1.245249E+13	0.00001542	0.00050011	32.43988055	1530.05281	42706.45097
1.970610E+08	1.244596E+13	0.00001583	0.00051399	32.46227235	1566.05158	43850.39781
2.021402E+08	1.243940E+13	0.00001625	0.00052788	32.48477429	1601.75456	44993.75160
2.122808E+08	1.242619E+13	0.00001708	0.00055572	32.53012437	1672.26881	47278.65630
2.223975E+08	1.241288E+13	0.00001792	0.00058365	32.57594651	1741.58621	49561.12379
2.324898E+08	1.239946E+13	0.00001875	0.00061167	32.62224466	1809.69661	51841.11772
2.425576E+08	1.238592E+13	0.00001958	0.00063977	32.66903061	1876.59000	54118.59688
2.526004E+08	1.237227E+13	0.00002042	0.00066796	32.71631223	1942.25590	56393.52123
2.626180E+08	1.235850E+13	0.00002125	0.00069624	32.76410919	2006.68416	58665.84273
2.721121E+08	1.232206E+13	0.00002208	0.00072411	32.78967565	2068.72058	60000.00000
2.795383E+08	1.219804E+13	0.00002292	0.00074996	32.72565132	2124.87068	60000.00000
2.858830E+08	1.203718E+13	0.00002375	0.00077475	32.62121004	2177.48620	60000.00000
2.913909E+08	1.185319E+13	0.00002458	0.00079869	32.48905045	2227.16671	60000.00000
2.963306E+08	1.165891E+13	0.00002542	0.00082203	32.34232360	2274.58154	60000.00000
3.007969E+08	1.145893E+13	0.00002625	0.00084487	32.18566364	2319.98265	60000.00000
3.048770E+08	1.125700E+13	0.00002708	0.00086729	32.02311462	2363.60474	60000.00000
3.086357E+08	1.105561E+13	0.00002792	0.00088936	31.85755616	2405.62971	60000.00000
3.120117E+08	1.085258E+13	0.00002875	0.00091096	31.68568772	2445.90409	60000.00000
3.151933E+08	1.065442E+13	0.00002958	0.00093235	31.51608127	2484.93178	60000.00000
3.181679E+08	1.046031E+13	0.00003042	0.00095350	31.34785169	2522.69974	60000.00000
3.208838E+08	1.026828E+13	0.00003125	0.00097431	31.17791480	2559.06830	60000.00000

3.235065E+08	1.008332E+13	0.00003208	0.00099503	31.01396137	2594.50546	60000.00000
3.258804E+08	9.900165E+12	0.00003292	0.00101541	30.84788758	2628.58566	60000.00000
3.283735E+08	9.729584E+12	0.00003375	0.00103936	30.79570431	2667.96070	60000.00000
3.305070E+08	9.556830E+12	0.00003458	0.00105898	30.62122375	2699.19589	60000.00000
3.324844E+08	9.387796E+12	0.00003542	0.00107837	30.44806498	2729.35608	60000.00000
3.344561E+08	9.226374E+12	0.00003625	0.00109779	30.28375357	2758.90365	60000.00000
3.361933E+08	9.065887E+12	0.00003708	0.00111678	30.11552793	2787.13879	60000.00000
3.378986E+08	8.911611E+12	0.00003792	0.00113576	29.95411187	2814.70462	60000.00000
3.395986E+08	8.763835E+12	0.00003875	0.00115477	29.80043381	2841.68159	60000.00000
3.410842E+08	8.616863E+12	0.00003958	0.00117336	29.64275891	2867.42591	60000.00000
3.425468E+08	8.475384E+12	0.00004042	0.00119194	29.49135464	2892.54946	60000.00000
3.440045E+08	8.339502E+12	0.00004125	0.00121055	29.34677964	2917.10627	60000.00000
3.453646E+08	8.206683E+12	0.00004208	0.00122898	29.20355004	2940.80774	60000.00000
3.466128E+08	8.076414E+12	0.00004292	0.00124719	29.06078070	2963.62760	60000.00000
3.478564E+08	7.951003E+12	0.00004375	0.00126543	28.92408925	2985.90138	60000.00000
3.490955E+08	7.830178E+12	0.00004458	0.00128369	28.79314131	3007.62660	60000.00000
3.502570E+08	7.712081E+12	0.00004542	0.00130180	28.66357809	3028.57976	60000.00000
3.506722E+08	7.582101E+12	0.00004625	0.00132275	28.59999830	3052.26388	60000.00000
3.526325E+08	7.489539E+12	0.00004708	0.00134318	28.52766949	3074.58539	60000.00000
3.536482E+08	7.380485E+12	0.00004792	0.00136049	28.39274830	3092.76550	60000.00000
3.546602E+08	7.275081E+12	0.00004875	0.00137782	28.26298445	3110.45125	60000.00000
3.555833E+08	7.171429E+12	0.00004958	0.00139492	28.13280362	3127.36882	60000.00000
3.572817E+08	6.971350E+12	0.00005125	0.00142876	27.87832314	3159.33829	60000.00000
3.589660E+08	6.783609E+12	0.00005292	0.00146271	27.64178127	3189.40607	60000.00000
3.605100E+08	6.604763E+12	0.00005458	0.00149633	27.41359109	3217.18780	60000.00000
3.619065E+08	6.433893E+12	0.00005625	0.00152958	27.19245046	3242.72053	60000.00000
3.632898E+08	6.272629E+12	0.00005792	0.00156292	26.98574334	3266.40488	60000.00000
3.646301E+08	6.119666E+12	0.00005958	0.00159626	26.79034621	3288.14756	60000.00000
3.657706E+08	5.971764E+12	0.00006125	0.00162897	26.59535033	3307.58501	60000.00000
3.668986E+08	5.831501E+12	0.00006292	0.00166177	26.41222304	3325.22083	60000.00000
3.683458E+08	5.703419E+12	0.00006458	0.00170424	26.38820261	3345.53088	60000.00000
3.693951E+08	5.575775E+12	0.00006625	0.00173585	26.20158201	3358.37736	60000.00000
3.702605E+08	5.451689E+12	0.00006792	0.00176669	26.01267189	3369.23024	60000.00000
3.711042E+08	5.333234E+12	0.00006958	0.00179757	25.83327788	3378.45625	60000.00000
3.719375E+08	5.220176E+12	0.00007125	0.00182853	25.66355735	3386.06356	60000.00000
3.727603E+08	5.112142E+12	0.00007292	0.00185958	25.50286120	3392.03686	60000.00000
3.735690E+08	5.008747E+12	0.00007458	0.00189071	25.35032791	3396.35813	60000.00000
3.742233E+08	4.907847E+12	0.00007625	0.00192109	25.19463569	3398.96330	60000.00000
3.748678E+08	4.811137E+12	0.00007792	0.00195156	25.04676408	3399.98441	60000.00000
3.754819E+08	4.718097E+12	0.00007958	0.00198212	24.90622920	3393.47093	60000.00000
3.760877E+08	4.628772E+12	0.00008125	0.00201277	24.77259833	3385.85592	60000.00000
3.766889E+08	4.542982E+12	0.00008292	0.00204352	24.64547020	3390.28101	60000.00000
3.772852E+08	4.460514E+12	0.00008458	0.00207436	24.52446717	3394.58368	60000.00000
3.777768E+08	4.380021E+12	0.00008625	0.00210460	24.40119034	3397.57963	60000.00000
3.782499E+08	4.302369E+12	0.00008792	0.00213484	24.28250831	3399.38470	60000.00000
3.782499E+08	4.222325E+12	0.00008958	0.00216792	24.19999856	3399.35998	60000.00000
3.785457E+08	4.148446E+12	0.00009125	0.00220825	24.19999856	3390.15594	60000.00000
3.799668E+08	4.089329E+12	0.00009292	0.00224281	24.13785464	3382.47763	60000.00000
3.803819E+08	4.021659E+12	0.00009458	0.00227198	24.02094680	3386.43806	60000.00000
3.807947E+08	3.956308E+12	0.00009625	0.00230122	23.90880686	3390.65692	60000.00000
3.812051E+08	3.893158E+12	0.00009792	0.00233053	23.80120665	3394.10273	60000.00000
3.815485E+08	3.831449E+12	0.00009958	0.00235927	23.69145066	3396.69455	60000.00000
3.818629E+08	3.771485E+12	0.00010125	0.00238781	23.58331937	3398.52615	60000.00000
3.821752E+08	3.713443E+12	0.00010292	0.00241642	23.47933835	3399.63052	60000.00000
3.824854E+08	3.657231E+12	0.00010458	0.00244509	23.37932271	3399.99740	60000.00000
3.827868E+08	3.602699E+12	0.00010625	0.00247398	23.28455490	3394.78418	60000.00000
3.830870E+08	3.549841E+12	0.00010792	0.00250293	23.19314665	3389.55864	60000.00000
3.833650E+08	3.498388E+12	0.00010958	0.00253235	23.10890204	3384.20618	60000.00000
3.836295E+08	3.448355E+12	0.00011125	0.00256208	23.02995247	3378.77226	60000.00000
3.838801E+08	3.399676E+12	0.00011292	0.00259213	22.95616418	3378.93161	60000.00000
3.841291E+08	3.352399E+12	0.00011458	0.00262224	22.88501555	3383.58659	60000.00000
3.843353E+08	3.306110E+12	0.00011625	0.00265216	22.81430358	3387.62034	60000.00000
3.846572E+08	3.216645E+12	0.00011958	0.00271194	22.67823368	3393.97390	60000.00000
3.849731E+08	3.131985E+12	0.00012292	0.00277195	22.55147141	3398.08523	60000.00000
3.852586E+08	3.051553E+12	0.00012625	0.00283283	22.43823391	3399.91839	60000.00000
3.855131E+08	2.975021E+12	0.00012958	0.00289462	22.33791929	3392.87606	60000.00000
3.857602E+08	2.902271E+12	0.00013292	0.00295670	22.24478406	3383.25441	60000.00000
3.860036E+08	2.833054E+12	0.00013625	0.00301896	22.15749854	3373.58622	60000.00000
3.862154E+08	2.766917E+12	0.00013958	0.00308218	22.08129877	3372.04150	60000.00000
3.863390E+08	2.703247E+12	0.00014292	0.00314428	22.00082678	3380.81542	60000.00000
3.878648E+08	2.652067E+12	0.00014625	0.00321750	22.00000066	3390.22842	60000.00000
3.893390E+08	2.602824E+12	0.00014958	0.00329083	22.00000066	3396.50984	60000.00000
3.907463E+08	2.555289E+12	0.00015292	0.00336417	22.00000066	3399.62741	60000.00000
3.918816E+08	2.508043E+12	0.00015625	0.00343750	22.00000066	3394.51569	60000.00000
3.918816E+08	2.455655E+12	0.00015958	0.00350985	21.99381262	3384.11931	60000.00000
3.918816E+08	2.405412E+12	0.00016292	0.00357301	21.93154281	3376.14802	60000.00000
3.918816E+08	2.357183E+12	0.00016625	0.00363634	21.87275058	3368.13365	60000.00000
3.918816E+08	2.310850E+12	0.00016958	0.00369984	21.81725496	3360.07514	60000.00000
3.918816E+08	2.266304E+12	0.00017292	0.00376351	21.76489466	3361.62745	60000.00000
3.918816E+08	2.223442E+12	0.00017625	0.00382736	21.71552414	3370.17444	60000.00000

```
Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 =  385929.47495 in-kip



p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number            =            1
Depth below pile head        =       60.000 in
Depth below ground surface   =       48.000 in
Equivalent Depth (see note)  =       48.000 in
Pile Diameter                =      132.000 in
Angle of Friction            =       46.000 deg.
Avg. Eff. Unit Weight        =      0.05300 pci
k                            =      225.000 pci
A (static)                   =       2.5755
B (static)                   =       1.9145
Pst                          =     2979.144 lbs/in
Psd                          =    82368.160 lbs/in
Ps                           =     2979.144 lbs/in
Cbar                         =    4587.6751
n                            =       3.6210
m                            =     715.9795
yk                           =       0.3064 in
pm                           =     5703.707 lbs/in
ym                           =       2.2000 in
pu                           =     7672.651 lbs/in
yu                           =       4.9500 in
p-multiplier                 =      1.00000
y-multiplier                 =      1.00000

This p-y curve is computed using the equivalent depth.

        y, in              p, lbs/in
----------------    -----------------
          0.0000           0.0000
       0.1833333        1980.0000   *
       0.3666667        3477.4460
       0.5500000        3889.4693
       0.7333333        4211.0834
       0.9166667        4478.7502
          1.1000        4710.0313
          1.2833        4914.8701
          1.4667        5099.4965
          1.6500        5268.0968
          1.8333        5423.6329
          2.0167        5568.2847
          2.2000        5703.7075
          3.5750        6688.1793
          4.9500        7672.6512
        136.9500        7672.6512
        268.9500        7672.6512

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.



p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number            =            3
Depth below pile head        =      174.000 in
Depth below ground surface   =      162.000 in
Equivalent Depth (see note)  =      190.352 in
Pile Diameter                =      132.000 in
Angle of Friction            =       25.000 deg.
Avg. Eff. Unit Weight        =      0.06404 pci
k                            =       25.000 pci
A (static)                   =       1.8006
B (static)                   =       1.3013
Pst                          =     6137.801 lbs/in
Psd                          =    21477.967 lbs/in
Ps                           =     6137.801 lbs/in
Cbar                         =    6270.2141
n                            =       3.2580
m                            =    1114.3340
yk                           =       1.4888 in
```

```
pm                            =     7987.031 lbs/in
ym                            =       2.2000 in
pu                            =    11051.450 lbs/in
yu                            =       4.9500 in
p-multiplier                  =      1.00000
y-multiplier                  =      1.00000

This p-y curve is computed using the equivalent depth.

        y, in            p, lbs/in
----------------    -----------------
         0.0000            0.0000
      0.1833333          872.4486   *
      0.3666667         1744.8973   *
      0.5500000         2617.3459   *
      0.7333333         3489.7946   *
      0.9166667         4362.2432   *
         1.1000         5234.6918   *
         1.2833         6107.1405   *
         1.4667         6979.5891   *
         1.6500         7312.0099
         1.8333         7552.3403
         2.0167         7776.5433
         2.2000         7987.0314
         3.5750         9519.2407
         4.9500        11051.4500
       136.9500        11051.4500
       268.9500        11051.4500

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.




p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number             =            4
Depth below pile head         =      348.000 in
Depth below ground surface    =      336.000 in
Equivalent Depth (see note)   =      250.427 in
Pile Diameter                 =      132.000 in
Angle of Friction             =       39.000 deg.
Avg. Eff. Unit Weight         =      0.06616 pci
k                             =      225.000 pci
A (static)                    =       1.5376
B (static)                    =       1.0952
Pst                           =    26664.690 lbs/in
Psd                           =   266889.574 lbs/in
Ps                            =    26664.690 lbs/in
Cbar                          =   22636.5790
n                             =       3.0950
m                             =    4289.0297
yk                            =       0.2600 in
pm                            =    29204.313 lbs/in
ym                            =       2.2000 in
pu                            =    40999.145 lbs/in
yu                            =       4.9500 in
p-multiplier                  =      1.00000
y-multiplier                  =      1.00000

This p-y curve is computed using the equivalent depth.

        y, in            p, lbs/in
----------------    -----------------
         0.0000            0.0000
      0.1833333        10330.1188   *
      0.3666667        16369.2059
      0.5500000        18660.4626
      0.7333333        20478.1116
      0.9166667        22009.0538
         1.1000        23344.5067
         1.2833        24536.6404
         1.4667        25618.4117
         1.6500        26612.1214
         1.8333        27533.6423
         2.0167        28394.7190
         2.2000        29204.3131
```

3.5750	35101.7290
4.9500	40999.1449
136.9500	40999.1449
268.9500	40999.1449

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 221503.000 lbs
Specified moment at pile head = 235128000.000 in-lbs
Specified axial load at pile head = 117367.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	2.151	2.35E+08	2.22E+05	-0.009302	1049.893	1.24E+13	0.000	0.000
4.800	2.106	2.36E+08	2.22E+05	-0.009210	1054.624	1.24E+13	0.000	0.000
9.600	2.062	2.37E+08	2.22E+05	-0.009119	1059.356	1.24E+13	0.000	0.000
14.400	2.019	2.38E+08	2.22E+05	-0.009027	1064.087	1.24E+13	0.000	0.000
19.200	1.976	2.39E+08	2.22E+05	-0.008934	1068.818	1.24E+13	0.000	0.000
24.000	1.933	2.40E+08	2.22E+05	-0.008841	1073.549	1.24E+13	0.000	0.000
28.800	1.891	2.42E+08	2.22E+05	-0.008748	1078.280	1.24E+13	0.000	0.000
33.600	1.849	2.43E+08	2.22E+05	-0.008654	1083.010	1.24E+13	0.000	0.000
38.400	1.808	2.44E+08	2.22E+05	-0.008560	1087.740	1.24E+13	0.000	0.000
43.200	1.767	2.45E+08	2.14E+05	-0.008465	1092.470	1.24E+13	-3221.291	8751.246
48.000	1.726	2.46E+08	1.97E+05	-0.008370	1096.871	1.24E+13	-3785.531	10525.
52.800	1.687	2.47E+08	1.77E+05	-0.008274	1100.886	1.24E+13	-4362.609	12417.
57.600	1.647	2.47E+08	1.55E+05	-0.008179	1104.455	1.24E+13	-4950.612	14428.
62.400	1.608	2.48E+08	1.30E+05	-0.008083	1107.519	1.24E+13	-5547.638	16560.
67.200	1.569	2.49E+08	1.02E+05	-0.007986	1110.016	1.24E+13	-6151.792	18815.
72.000	1.531	2.49E+08	75600.	-0.007890	1111.885	1.24E+13	-4753.997	14902.
76.800	1.494	2.49E+08	57987.	-0.007793	1113.269	1.24E+13	-2584.728	8306.104
81.600	1.457	2.50E+08	45114.	-0.007696	1114.390	1.24E+13	-2779.182	9158.935
86.400	1.420	2.50E+08	31320.	-0.007599	1115.226	1.24E+13	-2968.264	10035.
91.200	1.384	2.50E+08	16631.	-0.007502	1115.759	1.24E+13	-3152.068	10936.
96.000	1.348	2.50E+08	1072.507	-0.007405	1115.970	1.24E+13	-3330.613	11862.
100.800	1.312	2.50E+08	-15330.	-0.007308	1115.842	1.24E+13	-3503.861	12814.
105.600	1.278	2.50E+08	-32552.	-0.007212	1115.355	1.24E+13	-3671.737	13795.
110.400	1.243	2.50E+08	-50305.	-0.007115	1114.494	1.24E+13	-3725.292	14383.
115.200	1.209	2.49E+08	-68290.	-0.007018	1113.252	1.24E+13	-3768.777	14959.
120.000	1.176	2.49E+08	-86469.	-0.006921	1111.625	1.24E+13	-3805.624	15535.
124.800	1.143	2.49E+08	-1.05E+05	-0.006825	1109.610	1.24E+13	-3835.999	16111.
129.600	1.110	2.48E+08	-1.23E+05	-0.006728	1107.203	1.24E+13	-3860.065	16687.
134.400	1.078	2.47E+08	-1.42E+05	-0.006632	1104.402	1.24E+13	-4063.832	18090.
139.200	1.047	2.47E+08	-1.62E+05	-0.006536	1101.187	1.24E+13	-4070.321	18666.
144.000	1.016	2.46E+08	-1.81E+05	-0.006441	1097.555	1.24E+13	-4071.065	19242.
148.800	0.984841	2.45E+08	-2.01E+05	-0.006346	1093.508	1.24E+13	-4066.224	19818.
153.600	0.954609	2.44E+08	-2.20E+05	-0.006251	1089.046	1.24E+13	-4055.954	20394.
158.400	0.924831	2.43E+08	-2.40E+05	-0.006157	1084.170	1.24E+13	-4040.412	20970.
163.200	0.895505	2.42E+08	-2.59E+05	-0.006063	1078.881	1.24E+13	-4019.750	21546.
168.000	0.866628	2.40E+08	-2.78E+05	-0.005969	1073.182	1.24E+13	-3994.122	22122.
172.800	0.838198	2.39E+08	-2.97E+05	-0.005877	1067.075	1.24E+13	-3963.678	22698.
177.600	0.810212	2.38E+08	-3.16E+05	-0.005784	1060.563	1.24E+13	-3928.565	23274.
182.400	0.782668	2.36E+08	-3.35E+05	-0.005693	1053.650	1.24E+13	-3888.931	23850.
187.200	0.755563	2.34E+08	-3.54E+05	-0.005602	1046.341	1.24E+13	-3844.917	24426.
192.000	0.728893	2.33E+08	-3.72E+05	-0.005511	1038.638	1.24E+13	-3796.668	25002.
196.800	0.702656	2.31E+08	-3.90E+05	-0.005421	1030.548	1.24E+13	-3744.320	25578.
201.600	0.676847	2.29E+08	-4.08E+05	-0.005333	1022.076	1.24E+13	-3688.011	26154.
206.400	0.651463	2.27E+08	-4.26E+05	-0.005244	1013.227	1.24E+13	-3627.876	26730.
211.200	0.626501	2.25E+08	-4.43E+05	-0.005157	1004.008	1.24E+13	-3564.044	27306.
216.000	0.601956	2.23E+08	-4.60E+05	-0.005071	994.425	1.24E+13	-3496.646	27882.
220.800	0.577824	2.20E+08	-4.76E+05	-0.004985	984.485	1.24E+13	-3425.807	28458.
225.600	0.554101	2.18E+08	-4.93E+05	-0.004900	974.195	1.24E+13	-3351.650	29034.
230.400	0.530782	2.16E+08	-5.09E+05	-0.004816	963.563	1.24E+13	-3274.294	29610.
235.200	0.507864	2.13E+08	-5.24E+05	-0.004734	952.597	1.24E+13	-3193.858	30186.
240.000	0.485340	2.11E+08	-5.39E+05	-0.004652	941.304	1.24E+13	-3110.454	30762.
244.800	0.463207	2.08E+08	-5.54E+05	-0.004571	929.694	1.24E+13	-3024.193	31338.
249.600	0.441460	2.05E+08	-5.68E+05	-0.004491	917.775	1.24E+13	-2935.184	31914.

254.400	0.420093	2.03E+08	-5.82E+05	-0.004412	905.557	1.24E+13	-2843.530	32490.
259.200	0.399101	2.00E+08	-5.96E+05	-0.004335	893.048	1.24E+13	-2749.332	33066.
264.000	0.378479	1.97E+08	-6.09E+05	-0.004258	880.258	1.24E+13	-2652.688	33642.
268.800	0.358221	1.94E+08	-6.21E+05	-0.004183	867.198	1.25E+13	-2553.692	34218.
273.600	0.338322	1.91E+08	-6.33E+05	-0.004109	853.877	1.25E+13	-2452.436	34794.
278.400	0.318777	1.88E+08	-6.45E+05	-0.004036	840.305	1.25E+13	-2349.005	35370.
283.200	0.299578	1.85E+08	-6.78E+05	-0.003964	826.494	1.25E+13	-11605.	1.86E+05
288.000	0.280721	1.81E+08	-7.34E+05	-0.003894	811.498	1.25E+13	-11661.	1.99E+05
292.800	0.262199	1.78E+08	-7.90E+05	-0.003825	795.312	1.25E+13	-11517.	2.11E+05
297.600	0.244006	1.74E+08	-8.43E+05	-0.003757	777.951	1.25E+13	-10982.	2.16E+05
302.400	0.226133	1.70E+08	-8.95E+05	-0.003691	759.469	1.25E+13	-10422.	2.21E+05
307.200	0.208573	1.65E+08	-9.43E+05	-0.003627	739.923	1.25E+13	-9837.564	2.26E+05
312.000	0.191318	1.60E+08	-9.89E+05	-0.003564	719.374	1.25E+13	-9230.327	2.32E+05
316.800	0.174358	1.56E+08	-1.03E+06	-0.003503	697.882	1.25E+13	-8600.420	2.37E+05
321.600	0.157686	1.51E+08	-1.07E+06	-0.003444	675.513	1.25E+13	-7948.344	2.42E+05
326.400	0.141291	1.45E+08	-1.11E+06	-0.003388	652.332	1.25E+13	-7274.543	2.47E+05
331.200	0.125164	1.40E+08	-1.14E+06	-0.003333	628.410	1.25E+13	-6579.400	2.52E+05
336.000	0.109295	1.34E+08	-1.17E+06	-0.003280	603.815	1.25E+13	-5863.242	2.58E+05
340.800	0.093673	1.29E+08	-1.20E+06	-0.003230	578.623	1.25E+13	-5126.338	2.63E+05
345.600	0.078287	1.23E+08	-1.22E+06	-0.003200	552.907	5.94E+13	-4368.897	2.68E+05
350.400	0.062949	1.17E+08	-1.24E+06	-0.003191	526.745	5.94E+13	-3580.937	2.73E+05
355.200	0.047657	1.11E+08	-1.25E+06	-0.003181	500.218	5.95E+13	-2762.477	2.78E+05
360.000	0.032407	1.05E+08	-1.27E+06	-0.003173	473.409	5.95E+13	-1913.526	2.83E+05
364.800	0.017198	9.89E+07	-1.27E+06	-0.003165	446.405	5.96E+13	-1034.077	2.89E+05
369.600	0.002028	9.27E+07	-1.28E+06	-0.003157	419.295	5.97E+13	-124.115	2.94E+05
374.400	-0.013107	8.66E+07	-1.27E+06	-0.003150	392.172	5.97E+13	816.386	2.99E+05
379.200	-0.028208	8.05E+07	-1.27E+06	-0.003143	365.133	5.98E+13	1787.461	3.04E+05
384.000	-0.043279	7.44E+07	-1.26E+06	-0.003137	338.276	5.99E+13	2789.156	3.09E+05
388.800	-0.058321	6.84E+07	-1.24E+06	-0.003131	311.704	5.99E+13	3821.527	3.15E+05
393.600	-0.073336	6.25E+07	-1.22E+06	-0.003126	285.522	6.00E+13	4884.637	3.20E+05
398.400	-0.088328	5.67E+07	-1.19E+06	-0.003121	259.838	6.01E+13	5925.611	3.22E+05
403.200	-0.103297	5.11E+07	-1.16E+06	-0.003117	234.758	6.01E+13	7041.440	3.27E+05
408.000	-0.118247	4.56E+07	-1.13E+06	-0.003113	210.398	6.02E+13	8188.250	3.32E+05
412.800	-0.133180	4.03E+07	-1.08E+06	-0.003109	186.872	6.02E+13	9366.125	3.38E+05
417.600	-0.148098	3.52E+07	-1.04E+06	-0.003106	164.303	6.03E+13	10575.	3.43E+05
422.400	-0.163001	3.03E+07	-9.83E+05	-0.003104	142.812	6.03E+13	11815.	3.48E+05
427.200	-0.177894	2.57E+07	-9.23E+05	-0.003102	122.527	6.04E+13	13087.	3.53E+05
432.000	-0.192776	2.15E+07	-8.57E+05	-0.003100	103.577	6.04E+13	14390.	3.58E+05
436.800	-0.207650	1.75E+07	-7.85E+05	-0.003098	86.096	6.04E+13	15725.	3.63E+05
441.600	-0.222518	1.39E+07	-7.06E+05	-0.003097	70.219	6.04E+13	16973.	3.66E+05
446.400	-0.237380	1.07E+07	-6.24E+05	-0.003096	56.075	6.04E+13	17434.	3.53E+05
451.200	-0.252239	7.93E+06	-5.39E+05	-0.003095	43.709	6.04E+13	17877.	3.40E+05
456.000	-0.267094	5.55E+06	-4.52E+05	-0.003095	33.167	6.04E+13	18304.	3.29E+05
460.800	-0.281947	3.59E+06	-3.63E+05	-0.003094	24.493	6.04E+13	18715.	3.19E+05
465.600	-0.296799	2.07E+06	-2.77E+05	-0.003094	17.728	6.04E+13	17388.	2.81E+05
470.400	-0.311650	9.40E+05	-1.90E+05	-0.003094	12.738	6.04E+13	18595.	2.86E+05
475.200	-0.326500	2.41E+05	-98251.	-0.003094	9.645	6.04E+13	19834.	2.92E+05
480.000	-0.341351	0.000	0.000	-0.003094	8.576	6.04E+13	21104.	1.48E+05

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection            =     2.15074035 in
Computed slope at pile head     =    -0.00930158
Maximum bending moment          =   2.500483E+08 lbs-in
Maximum shear force             =       -1275954. lbs
Depth of maximum bending moment =    96.00000000 in
Depth of maximum shear force    =      369.60000 in
Number of iterations            =             41
Number of zero deflection points =             1
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,         y = pile-head displacment in
Type 2 = Shear and Slope,          M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,    S = Pile-head Slope, radians
Type 5 = Deflection and Slope,     R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2            lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  2.22E+05 M=  2.35E+08    117367.      2.1507  2.5005E+08   -1275954.

The analysis ended normally.
```

B.6 Drained Analysis from 6.0 in. Triaxial Test (Ultimate)

```
===============================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method

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                             All Rights Reserved

===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                            Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using 6 inch Triax Friction Angles.lpd
Name of output file:         Drilled Shaft Analysis Using 6 inch Triax Friction Angles.lpo
Name of plot output file:    Drilled Shaft Analysis Using 6 inch Triax Friction Angles.lpp
Name of runtime file:        Drilled Shaft Analysis Using 6 inch Triax Friction Angles.lpr


------------------------------------------------------------------------------
                          Time and Date of Analysis
------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:  13:22:21


------------------------------------------------------------------------------
                                Problem Title
------------------------------------------------------------------------------

Drilled Shaft Analysis Using 6 in Friction Angles


------------------------------------------------------------------------------
                               Program Options
------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
```

```
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments            =         100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


-------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
-------------------------------------------------------------------------------

Pile Length                               =     480.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface             =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
          in            in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000   14902723.   13685.0000      3604997.
  2     480.0000     132.00000   14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.


-------------------------------------------------------------------------------
                      Soil and Rock Layering Information
-------------------------------------------------------------------------------

The soil profile is modelled using  8 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      12.000 in
Distance from top of pile to bottom of layer =      72.000 in
p-y subgrade modulus k for top of soil layer =       0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =       0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      72.000 in
Distance from top of pile to bottom of layer =     132.000 in
p-y subgrade modulus k for top of soil layer =       0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =       0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =     132.000 in
Distance from top of pile to bottom of layer =     282.000 in
p-y subgrade modulus k for top of soil layer =       0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =       0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  4 is sand, p-y criteria by Reese et al., 1974
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Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      462.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  6 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      462.000 in
Distance from top of pile to bottom of layer =      672.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  7 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      672.000 in
Distance from top of pile to bottom of layer =      732.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  8 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      732.000 in
Distance from top of pile to bottom of layer =     1200.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.


(Depth of lowest layer extends  720.00 in below pile tip)


------------------------------------------------------------------------------
                   Effective Unit Weight of Soil vs. Depth
------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 16 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           12.00        0.05300
  2           72.00        0.05300
  3           72.00        0.07300
  4          132.00        0.07300
  5          132.00        0.06700
  6          282.00        0.06700
  7          282.00        0.07000
  8          396.00        0.07000
  9          396.00        0.06900
 10          462.00        0.06900
 11          462.00        0.07100
 12          672.00        0.07100
 13          672.00        0.07200
 14          732.00        0.07200
 15          732.00        0.07100
 16         1200.00        0.07100


------------------------------------------------------------------------------
                           Shear Strength of Soils
------------------------------------------------------------------------------

Shear strength parameters with depth defined using 16 points
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Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	0.00000	24.00	------	------
4	132.000	0.00000	24.00	------	------
5	132.000	0.00000	25.00	------	------
6	282.000	0.00000	25.00	------	------
7	282.000	0.00000	39.00	------	------
8	396.000	0.00000	39.00	------	------
9	396.000	0.00000	39.00	------	------
10	462.000	0.00000	39.00	------	------
11	462.000	0.00000	48.00	------	------
12	672.000	0.00000	48.00	------	------
13	672.000	0.00000	39.00	------	------
14	732.000	0.00000	39.00	------	------
15	732.000	0.00000	48.00	------	------
16	1200.000	0.00000	48.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

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p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.001	1.0000	1.0000
4	1200.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 319693.000 lbs
Bending moment at pile head = 345051000.000 in-lbs
Axial load at pile head = 189766.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 3 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	48.000
2	174.000	162.000
3	348.000	336.000

Depth of ground surface below top of pile = 12.00 in

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Number of sections = 1

Pile Section No. 1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter = 132.0000 in

Material Properties:

```
Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =           90
Area of Single Bar                     =      1.27000 in**2
Number of Rows of Reinforcing Bars     =           45
Area of Steel                          =      114.300 in**2
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        0.835 percent
Cover Thickness (edge to bar center)   =        4.000 in
```

Unfactored Axial Squash Load Capacity = 52997.63 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	2.540	61.962
2	2.540	61.660
3	2.540	61.058
4	2.540	60.158
5	2.540	58.966
6	2.540	57.485
7	2.540	55.725
8	2.540	53.694
9	2.540	51.400
10	2.540	48.857
11	2.540	46.075
12	2.540	43.069
13	2.540	39.853
14	2.540	36.443
15	2.540	32.855
16	2.540	29.107
17	2.540	25.218
18	2.540	21.205
19	2.540	17.090
20	2.540	12.891
21	2.540	8.629
22	2.540	4.325
23	2.540	0.000
24	2.540	-4.325
25	2.540	-8.629
26	2.540	-12.891
27	2.540	-17.090
28	2.540	-21.205
29	2.540	-25.218
30	2.540	-29.107
31	2.540	-32.855
32	2.540	-36.443
33	2.540	-39.853

34	2.540	-43.069
35	2.540	-46.075
36	2.540	-48.857
37	2.540	-51.400
38	2.540	-53.694
39	2.540	-55.725
40	2.540	-57.485
41	2.540	-58.966
42	2.540	-60.158
43	2.540	-61.058
44	2.540	-61.660
45	2.540	-61.962

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25181408.	6.043538E+13	4.166667E-07	0.00002759	66.21742111	97.95383531	751.33747
50136430.	6.016372E+13	8.333333E-07	0.00005518	66.21697265	194.47463	1502.66409
74865067.	5.989205E+13	0.00000125	0.00008277	66.21652025	289.56242	2253.97974
99367320.	5.962039E+13	0.00000167	0.00011036	66.21605998	383.21724	3005.28408
1.236432E+08	5.934873E+13	0.00000208	0.00013795	66.21559578	475.43913	3756.57705
1.236432E+08	4.945727E+13	0.00000250	0.00007949	31.79650587	273.35193	6972.01509
1.236432E+08	4.239195E+13	0.00000292	0.00009280	31.81586856	317.99257	8132.37985
1.236432E+08	3.709296E+13	0.00000333	0.00010612	31.83531779	362.36870	9292.26830
1.236432E+08	3.297152E+13	0.00000375	0.00011946	31.85484964	406.47939	10451.67775
1.236432E+08	2.967436E+13	0.00000417	0.00013281	31.87446803	450.32382	11610.60473
1.236432E+08	2.697670E+13	0.00000458	0.00014618	31.89417690	493.90115	12769.04556
1.236432E+08	2.472864E+13	0.00000500	0.00015957	31.91396838	537.21037	13926.99812
1.236432E+08	2.282643E+13	0.00000542	0.00017298	31.93385428	580.25077	15084.45755
1.236432E+08	2.119597E+13	0.00000583	0.00018640	31.95382673	623.02128	16241.42177
1.236432E+08	1.978291E+13	0.00000625	0.00019984	31.97388965	665.52107	17397.88692
1.236432E+08	1.854648E+13	0.00000667	0.00021329	31.99404305	707.74918	18553.84972
1.236432E+08	1.745551E+13	0.00000708	0.00022677	32.01428694	749.70467	19709.30690
1.236432E+08	1.648576E+13	0.00000750	0.00024026	32.03462523	791.38666	20864.25431
1.236432E+08	1.561809E+13	0.00000792	0.00025377	32.05505794	832.79420	22018.68854
1.236432E+08	1.483718E+13	0.00000833	0.00026730	32.07558507	873.92631	23172.60617
1.236432E+08	1.413065E+13	0.00000875	0.00028084	32.09620661	914.78199	24326.00376
1.236432E+08	1.348835E+13	0.00000917	0.00029441	32.11692256	955.36025	25478.87790
1.236432E+08	1.290190E+13	0.00000958	0.00030799	32.13773686	995.66017	26631.22407
1.253513E+08	1.253513E+13	0.00001000	0.00032159	32.15864950	1035.68073	27783.03871
1.305096E+08	1.252892E+13	0.00001042	0.00033520	32.17966443	1075.42102	28934.31707
1.356625E+08	1.252269E+13	0.00001083	0.00034884	32.20077378	1114.87976	30085.05790
1.408098E+08	1.251643E+13	0.00001125	0.00036250	32.22198540	1154.05612	31235.25522
1.459517E+08	1.251015E+13	0.00001167	0.00037617	32.24330324	1192.94917	32384.90399
1.510881E+08	1.250384E+13	0.00001208	0.00038987	32.26471943	1231.55756	33534.00311
1.562189E+08	1.249751E+13	0.00001250	0.00040358	32.28624183	1269.88047	34682.54617
1.613441E+08	1.249116E+13	0.00001292	0.00041731	32.30786651	1307.91664	35830.53080
1.664637E+08	1.248477E+13	0.00001333	0.00043106	32.32959741	1345.66510	36977.95176
1.715776E+08	1.247837E+13	0.00001375	0.00044483	32.35143453	1383.12470	38124.80520
1.766858E+08	1.247194E+13	0.00001417	0.00045862	32.37338179	1420.29446	39271.08566
1.817883E+08	1.246548E+13	0.00001458	0.00047243	32.39543921	1457.17321	40416.78915
1.868850E+08	1.245900E+13	0.00001500	0.00048626	32.41760284	1493.75962	41561.91337
1.919759E+08	1.245249E+13	0.00001542	0.00050011	32.43988055	1530.05281	42706.45097
1.970610E+08	1.244596E+13	0.00001583	0.00051399	32.46227235	1566.05158	43850.39781
2.021402E+08	1.243940E+13	0.00001625	0.00052788	32.48477429	1601.75456	44993.75160
2.122808E+08	1.242619E+13	0.00001708	0.00055572	32.53012437	1672.26881	47278.65630
2.223975E+08	1.241288E+13	0.00001792	0.00058365	32.57594651	1741.58621	49561.12379
2.324898E+08	1.239946E+13	0.00001875	0.00061167	32.62224466	1809.69661	51841.11772
2.425576E+08	1.238592E+13	0.00001958	0.00063977	32.66903061	1876.59000	54118.59688
2.526004E+08	1.237227E+13	0.00002042	0.00066796	32.71631223	1942.25590	56393.52123
2.626180E+08	1.235850E+13	0.00002125	0.00069624	32.76410919	2006.68416	58665.84273
2.721121E+08	1.232206E+13	0.00002208	0.00072411	32.78967565	2068.72058	60000.00000
2.795383E+08	1.219804E+13	0.00002292	0.00074996	32.72565132	2124.87068	60000.00000
2.858830E+08	1.203718E+13	0.00002375	0.00077475	32.62121004	2177.48620	60000.00000
2.913909E+08	1.185319E+13	0.00002458	0.00079869	32.48905045	2227.16671	60000.00000
2.963306E+08	1.165891E+13	0.00002542	0.00082203	32.34232360	2274.58154	60000.00000
3.007969E+08	1.145893E+13	0.00002625	0.00084487	32.18566364	2319.98265	60000.00000
3.048770E+08	1.125700E+13	0.00002708	0.00086729	32.02311462	2363.60474	60000.00000
3.086357E+08	1.105561E+13	0.00002792	0.00088936	31.85755616	2405.62971	60000.00000
3.120117E+08	1.085258E+13	0.00002875	0.00091096	31.68568772	2445.90409	60000.00000
3.151933E+08	1.065442E+13	0.00002958	0.00093235	31.51608127	2484.93178	60000.00000
3.181679E+08	1.046031E+13	0.00003042	0.00095350	31.34785169	2522.69974	60000.00000
3.208838E+08	1.026828E+13	0.00003125	0.00097431	31.17791480	2559.06830	60000.00000
3.235065E+08	1.008332E+13	0.00003208	0.00099503	31.01396137	2594.50546	60000.00000
3.258804E+08	9.900165E+12	0.00003292	0.00101541	30.84788758	2628.58566	60000.00000
3.283735E+08	9.729584E+12	0.00003375	0.00103936	30.79570431	2667.96070	60000.00000
3.305070E+08	9.556830E+12	0.00003458	0.00105898	30.62122375	2699.19589	60000.00000

3.324844E+08	9.387796E+12	0.00003542	0.00107837	30.44806498	2729.35608	60000.00000
3.344561E+08	9.226374E+12	0.00003625	0.00109779	30.28375357	2758.90365	60000.00000
3.361933E+08	9.065887E+12	0.00003708	0.00111678	30.11552793	2787.13879	60000.00000
3.378986E+08	8.911611E+12	0.00003792	0.00113576	29.95411187	2814.70462	60000.00000
3.395986E+08	8.763835E+12	0.00003875	0.00115477	29.80043381	2841.68159	60000.00000
3.410842E+08	8.616863E+12	0.00003958	0.00117336	29.64275891	2867.42591	60000.00000
3.425468E+08	8.475384E+12	0.00004042	0.00119194	29.49135464	2892.54946	60000.00000
3.440045E+08	8.339502E+12	0.00004125	0.00121055	29.34677964	2917.10627	60000.00000
3.453646E+08	8.206683E+12	0.00004208	0.00122898	29.20355004	2940.80774	60000.00000
3.466128E+08	8.076414E+12	0.00004292	0.00124719	29.06078070	2963.62760	60000.00000
3.478564E+08	7.951003E+12	0.00004375	0.00126543	28.92408925	2985.90138	60000.00000
3.490955E+08	7.830178E+12	0.00004458	0.00128369	28.79314131	3007.62660	60000.00000
3.502570E+08	7.712081E+12	0.00004542	0.00130180	28.66357809	3028.57976	60000.00000
3.506722E+08	7.582101E+12	0.00004625	0.00132275	28.59999830	3052.26388	60000.00000
3.526325E+08	7.489539E+12	0.00004708	0.00134318	28.52766949	3074.58539	60000.00000
3.536482E+08	7.380485E+12	0.00004792	0.00136049	28.39274830	3092.76550	60000.00000
3.546602E+08	7.275081E+12	0.00004875	0.00137782	28.26298445	3110.45125	60000.00000
3.555833E+08	7.171429E+12	0.00004958	0.00139492	28.13280362	3127.36882	60000.00000
3.572817E+08	6.971350E+12	0.00005125	0.00142876	27.87832314	3159.33829	60000.00000
3.589660E+08	6.783609E+12	0.00005292	0.00146271	27.64178127	3189.40607	60000.00000
3.605100E+08	6.604763E+12	0.00005458	0.00149633	27.41359109	3217.18780	60000.00000
3.619065E+08	6.433893E+12	0.00005625	0.00152958	27.19245046	3242.72053	60000.00000
3.632898E+08	6.272629E+12	0.00005792	0.00156292	26.98574334	3266.40488	60000.00000
3.646301E+08	6.119666E+12	0.00005958	0.00159626	26.79034621	3288.14756	60000.00000
3.657706E+08	5.971764E+12	0.00006125	0.00162897	26.59535033	3307.58501	60000.00000
3.668986E+08	5.831501E+12	0.00006292	0.00166177	26.41222304	3325.22083	60000.00000
3.683458E+08	5.703419E+12	0.00006458	0.00170424	26.38820261	3345.53088	60000.00000
3.693951E+08	5.575775E+12	0.00006625	0.00173585	26.20158201	3358.37736	60000.00000
3.702605E+08	5.451689E+12	0.00006792	0.00176669	26.01267189	3369.23024	60000.00000
3.711042E+08	5.333234E+12	0.00006958	0.00179757	25.83327788	3378.45625	60000.00000
3.719375E+08	5.220176E+12	0.00007125	0.00182853	25.66355735	3386.06356	60000.00000
3.727603E+08	5.112142E+12	0.00007292	0.00185958	25.50286120	3392.03686	60000.00000
3.735690E+08	5.008747E+12	0.00007458	0.00189071	25.35032791	3396.35813	60000.00000
3.742233E+08	4.907847E+12	0.00007625	0.00192109	25.19463569	3398.96330	60000.00000
3.748678E+08	4.811137E+12	0.00007792	0.00195156	25.04676408	3399.98441	60000.00000
3.754819E+08	4.718097E+12	0.00007958	0.00198212	24.90622920	3393.47093	60000.00000
3.760877E+08	4.628772E+12	0.00008125	0.00201277	24.77259833	3385.85592	60000.00000
3.766889E+08	4.542982E+12	0.00008292	0.00204352	24.64547020	3390.28101	60000.00000
3.772852E+08	4.460514E+12	0.00008458	0.00207436	24.52446717	3394.58368	60000.00000
3.777768E+08	4.380021E+12	0.00008625	0.00210460	24.40119034	3397.57963	60000.00000
3.782499E+08	4.302369E+12	0.00008792	0.00213484	24.28250831	3399.38470	60000.00000
3.782499E+08	4.222325E+12	0.00008958	0.00216792	24.19999856	3399.35998	60000.00000
3.785457E+08	4.148446E+12	0.00009125	0.00220825	24.19999856	3390.15594	60000.00000
3.799668E+08	4.089329E+12	0.00009292	0.00224281	24.13785464	3382.47763	60000.00000
3.803819E+08	4.021659E+12	0.00009458	0.00227198	24.02094680	3386.43806	60000.00000
3.807947E+08	3.956308E+12	0.00009625	0.00230122	23.90880686	3390.65692	60000.00000
3.812051E+08	3.893158E+12	0.00009792	0.00233053	23.80120665	3394.10273	60000.00000
3.815485E+08	3.831449E+12	0.00009958	0.00235927	23.69145066	3396.69455	60000.00000
3.818629E+08	3.771485E+12	0.00010125	0.00238781	23.58331937	3398.52615	60000.00000
3.821752E+08	3.713443E+12	0.00010292	0.00241642	23.47933835	3399.63052	60000.00000
3.824854E+08	3.657231E+12	0.00010458	0.00244509	23.37932271	3399.99740	60000.00000
3.827868E+08	3.602699E+12	0.00010625	0.00247398	23.28455490	3394.78418	60000.00000
3.830870E+08	3.549841E+12	0.00010792	0.00250293	23.19314665	3389.55864	60000.00000
3.833650E+08	3.498388E+12	0.00010958	0.00253235	23.10890204	3384.20618	60000.00000
3.836295E+08	3.448355E+12	0.00011125	0.00256208	23.02995247	3378.77226	60000.00000
3.838801E+08	3.399676E+12	0.00011292	0.00259213	22.95616418	3378.93161	60000.00000
3.841291E+08	3.352399E+12	0.00011458	0.00262224	22.88501555	3383.58659	60000.00000
3.843353E+08	3.306110E+12	0.00011625	0.00265216	22.81430358	3387.62034	60000.00000
3.846572E+08	3.216645E+12	0.00011958	0.00271194	22.67823368	3393.97390	60000.00000
3.849731E+08	3.131985E+12	0.00012292	0.00277195	22.55147141	3398.08523	60000.00000
3.852586E+08	3.051553E+12	0.00012625	0.00283283	22.43823391	3399.91839	60000.00000
3.855131E+08	2.975021E+12	0.00012958	0.00289462	22.33791929	3392.87606	60000.00000
3.857602E+08	2.902271E+12	0.00013292	0.00295670	22.24478406	3383.25441	60000.00000
3.860036E+08	2.833054E+12	0.00013625	0.00301896	22.15749854	3373.58622	60000.00000
3.862154E+08	2.766917E+12	0.00013958	0.00308218	22.08129877	3372.04150	60000.00000
3.863390E+08	2.703247E+12	0.00014292	0.00314428	22.00082678	3380.81542	60000.00000
3.878648E+08	2.652067E+12	0.00014625	0.00321750	22.00000066	3390.22842	60000.00000
3.893390E+08	2.602824E+12	0.00014958	0.00329083	22.00000066	3396.50984	60000.00000
3.907463E+08	2.555289E+12	0.00015292	0.00336417	22.00000066	3399.62741	60000.00000
3.918816E+08	2.508043E+12	0.00015625	0.00343750	22.00000066	3394.51569	60000.00000
3.918816E+08	2.455655E+12	0.00015958	0.00350985	21.99381262	3384.11931	60000.00000
3.918816E+08	2.405412E+12	0.00016292	0.00357301	21.93154281	3376.14802	60000.00000
3.918816E+08	2.357183E+12	0.00016625	0.00363634	21.87275058	3368.13365	60000.00000
3.918816E+08	2.310850E+12	0.00016958	0.00369984	21.81725496	3360.07514	60000.00000
3.918816E+08	2.266304E+12	0.00017292	0.00376351	21.76489466	3361.62745	60000.00000
3.918816E+08	2.223442E+12	0.00017625	0.00382736	21.71552414	3370.17444	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 385929.47495 in-kip

```
p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number            =           1
Depth below pile head        =      60.000 in
Depth below ground surface   =      48.000 in
Equivalent Depth (see note)  =      48.000 in
Pile Diameter                =     132.000 in
Angle of Friction            =      46.000 deg.
Avg. Eff. Unit Weight        =     0.05300 pci
k                            =     225.000 pci
A (static)                   =      2.5755
B (static)                   =      1.9145
Pst                          =    2979.144 lbs/in
Psd                          =   82368.160 lbs/in
Ps                           =    2979.144 lbs/in
Cbar                         =   4587.6751
n                            =      3.6210
m                            =    715.9795
yk                           =      0.3064 in
pm                           =    5703.707 lbs/in
ym                           =      2.2000 in
pu                           =    7672.651 lbs/in
yu                           =      4.9500 in
p-multiplier                 =     1.00000
y-multiplier                 =     1.00000

This p-y curve is computed using the equivalent depth.

        y, in            p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.1833333        1980.0000   *
      0.3666667        3477.4460
      0.5500000        3889.4693
      0.7333333        4211.0834
      0.9166667        4478.7502
         1.1000        4710.0313
         1.2833        4914.8701
         1.4667        5099.4965
         1.6500        5268.0968
         1.8333        5423.6329
         2.0167        5568.2847
         2.2000        5703.7075
         3.5750        6688.1793
         4.9500        7672.6512
       136.9500        7672.6512
       268.9500        7672.6512

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.




p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number            =           3
Depth below pile head        =     174.000 in
Depth below ground surface   =     162.000 in
Equivalent Depth (see note)  =     190.352 in
Pile Diameter                =     132.000 in
Angle of Friction            =      25.000 deg.
Avg. Eff. Unit Weight        =     0.06404 pci
k                            =      25.000 pci
A (static)                   =      1.8006
B (static)                   =      1.3013
Pst                          =    6137.801 lbs/in
Psd                          =   21477.967 lbs/in
Ps                           =    6137.801 lbs/in
Cbar                         =   6270.2141
n                            =      3.2580
m                            =   1114.3340
yk                           =      1.4888 in
pm                           =    7987.031 lbs/in
ym                           =      2.2000 in
pu                           =   11051.450 lbs/in
yu                           =      4.9500 in
```

```
p-multiplier                  =      1.00000
y-multiplier                  =      1.00000

This p-y curve is computed using the equivalent depth.

        y, in            p, lbs/in
----------------    -----------------
          0.0000            0.0000
       0.1833333          872.4486   *
       0.3666667         1744.8973   *
       0.5500000         2617.3459   *
       0.7333333         3489.7946   *
       0.9166667         4362.2432   *
          1.1000         5234.6918   *
          1.2833         6107.1405   *
          1.4667         6979.5891   *
          1.6500         7312.0099
          1.8333         7552.3403
          2.0167         7776.5433
          2.2000         7987.0314
          3.5750         9519.2407
          4.9500        11051.4500
        136.9500        11051.4500
        268.9500        11051.4500

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.




p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number             =            4
Depth below pile head         =      348.000 in
Depth below ground surface    =      336.000 in
Equivalent Depth (see note)   =      250.427 in
Pile Diameter                 =      132.000 in
Angle of Friction             =       39.000 deg.
Avg. Eff. Unit Weight         =      0.06616 pci
k                             =      225.000 pci
A (static)                    =       1.5376
B (static)                    =       1.0952
Pst                           =    26664.690 lbs/in
Psd                           =   266889.574 lbs/in
Ps                            =    26664.690 lbs/in
Cbar                          =   22636.5790
n                             =       3.0950
m                             =    4289.0297
yk                            =       0.2600 in
pm                            =    29204.313 lbs/in
ym                            =       2.2000 in
pu                            =    40999.145 lbs/in
yu                            =       4.9500 in
p-multiplier                  =      1.00000
y-multiplier                  =      1.00000

This p-y curve is computed using the equivalent depth.

        y, in            p, lbs/in
----------------    -----------------
          0.0000            0.0000
       0.1833333        10330.1188   *
       0.3666667        16369.2059
       0.5500000        18660.4626
       0.7333333        20478.1116
       0.9166667        22009.0538
          1.1000        23344.5067
          1.2833        24536.6404
          1.4667        25618.4117
          1.6500        26612.1214
          1.8333        27533.6423
          2.0167        28394.7190
          2.2000        29204.3131
          3.5750        35101.7290
          4.9500        40999.1449
        136.9500        40999.1449
        268.9500        40999.1449
```

```
* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.
```

```
-----------------------------------------------------------------------------
             Computed Values of Load Distribution and Deflection
                 for Lateral Loading for Load Case Number  1
-----------------------------------------------------------------------------

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head  =       319693.000 lbs
Specified moment at pile head       =    345051000.000 in-lbs
Specified axial load at pile head   =       189766.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	4.269	3.45E+08	3.20E+05	-0.020764	1542.001	8.08E+12	0.000	0.000
4.800	4.169	3.47E+08	3.20E+05	-0.020558	1548.881	8.08E+12	0.000	0.000
9.600	4.071	3.48E+08	3.20E+05	-0.020352	1555.759	8.08E+12	0.000	0.000
14.400	3.974	3.50E+08	3.20E+05	-0.020140	1562.637	7.77E+12	0.000	0.000
19.200	3.878	3.51E+08	3.20E+05	-0.019921	1569.514	7.55E+12	0.000	0.000
24.000	3.783	3.53E+08	3.20E+05	-0.019696	1576.389	7.47E+12	0.000	0.000
28.800	3.689	3.54E+08	3.20E+05	-0.019466	1583.264	7.31E+12	0.000	0.000
33.600	3.596	3.56E+08	3.20E+05	-0.019230	1590.139	7.13E+12	0.000	0.000
38.400	3.504	3.57E+08	3.20E+05	-0.018986	1597.012	6.95E+12	0.000	0.000
43.200	3.414	3.59E+08	3.10E+05	-0.018736	1603.884	6.78E+12	-3924.970	5518.858
48.000	3.324	3.60E+08	2.90E+05	-0.018478	1610.354	6.61E+12	-4603.151	6646.346
52.800	3.236	3.62E+08	2.66E+05	-0.018212	1616.354	6.44E+12	-5294.782	7852.999
57.600	3.150	3.63E+08	2.39E+05	-0.017939	1621.812	6.30E+12	-5997.766	9140.708
62.400	3.064	3.64E+08	2.08E+05	-0.017659	1626.658	6.17E+12	-6710.066	10511.
67.200	2.980	3.65E+08	1.75E+05	-0.017373	1630.817	6.06E+12	-7429.708	11967.
72.000	2.897	3.66E+08	1.43E+05	-0.017081	1634.218	5.96E+12	-5753.342	9531.485
76.800	2.816	3.67E+08	1.22E+05	-0.016784	1637.030	5.88E+12	-3121.487	5320.585
81.600	2.736	3.67E+08	1.06E+05	-0.016483	1639.522	5.82E+12	-3349.840	5876.427
86.400	2.658	3.68E+08	89433.	-0.016178	1641.671	5.77E+12	-3571.481	6450.023
91.200	2.581	3.68E+08	71773.	-0.015872	1643.455	5.74E+12	-3786.711	7042.547
96.000	2.505	3.68E+08	53095.	-0.015563	1644.851	5.71E+12	-3995.740	7655.071
100.800	2.432	3.68E+08	33429.	-0.015252	1645.838	5.69E+12	-4198.709	8288.592
105.600	2.359	3.69E+08	12802.	-0.014941	1646.395	5.67E+12	-4395.714	8944.050
110.400	2.288	3.69E+08	-8755.986	-0.014629	1646.502	5.67E+12	-4586.813	9622.354
115.200	2.219	3.69E+08	-31217.	-0.014317	1646.141	5.68E+12	-4772.040	10324.
120.000	2.151	3.68E+08	-54553.	-0.014006	1645.291	5.70E+12	-4951.141	11050.
124.800	2.084	3.68E+08	-78737.	-0.013697	1643.934	5.73E+12	-5125.682	11805.
129.600	2.019	3.68E+08	-1.04E+05	-0.013389	1642.054	5.77E+12	-5296.192	12590.
134.400	1.956	3.67E+08	-1.31E+05	-0.013085	1639.631	5.81E+12	-6115.937	15011.
139.200	1.894	3.66E+08	-1.61E+05	-0.012784	1636.584	5.89E+12	-6259.224	15867.
144.000	1.833	3.66E+08	-1.91E+05	-0.012488	1632.896	6.00E+12	-6395.494	16749.
148.800	1.774	3.65E+08	-2.22E+05	-0.012199	1628.555	6.12E+12	-6524.589	17657.
153.600	1.716	3.63E+08	-2.54E+05	-0.011917	1623.547	6.25E+12	-6646.351	18594.
158.400	1.659	3.62E+08	-2.86E+05	-0.011642	1617.860	6.40E+12	-6760.623	19558.
163.200	1.604	3.61E+08	-3.19E+05	-0.011374	1611.481	6.58E+12	-6867.245	20550.
168.000	1.550	3.59E+08	-3.52E+05	-0.011115	1604.401	6.76E+12	-6966.053	21572.
172.800	1.497	3.57E+08	-3.86E+05	-0.010864	1596.609	6.96E+12	-7056.883	22623.
177.600	1.446	3.55E+08	-4.19E+05	-0.010622	1588.096	7.19E+12	-7010.200	23274.
182.400	1.395	3.53E+08	-4.53E+05	-0.010389	1578.867	7.41E+12	-6933.175	23850.
187.200	1.346	3.51E+08	-4.86E+05	-0.010163	1568.929	7.56E+12	-6849.643	24426.
192.000	1.298	3.49E+08	-5.19E+05	-0.009945	1558.291	7.87E+12	-6759.847	25002.
196.800	1.251	3.46E+08	-5.51E+05	-0.009737	1546.963	8.12E+12	-6663.916	25578.
201.600	1.204	3.43E+08	-5.82E+05	-0.009536	1534.954	8.39E+12	-6562.001	26154.
206.400	1.159	3.41E+08	-6.14E+05	-0.009344	1522.275	8.66E+12	-6454.240	26730.
211.200	1.115	3.38E+08	-6.44E+05	-0.009159	1508.937	8.94E+12	-6340.759	27306.
216.000	1.071	3.34E+08	-6.75E+05	-0.008981	1494.950	9.23E+12	-6221.676	27882.
220.800	1.028	3.31E+08	-7.04E+05	-0.008810	1480.328	9.50E+12	-6097.098	28458.
225.600	0.986496	3.28E+08	-7.33E+05	-0.008646	1465.084	9.78E+12	-5967.130	29034.
230.400	0.945380	3.24E+08	-7.61E+05	-0.008488	1449.229	1.00E+13	-5831.872	29610.
235.200	0.905008	3.20E+08	-7.89E+05	-0.008336	1432.779	1.03E+13	-5691.426	30186.
240.000	0.865353	3.17E+08	-8.16E+05	-0.008190	1415.748	1.06E+13	-5545.882	30762.
244.800	0.826388	3.13E+08	-8.42E+05	-0.008048	1398.151	1.08E+13	-5395.328	31338.
249.600	0.788088	3.08E+08	-8.68E+05	-0.007912	1380.002	1.11E+13	-5239.849	31914.
254.400	0.750431	3.04E+08	-8.93E+05	-0.007781	1361.318	1.13E+13	-5079.526	32490.
259.200	0.713395	3.00E+08	-9.17E+05	-0.007653	1342.115	1.15E+13	-4914.444	33066.
264.000	0.676960	2.95E+08	-9.40E+05	-0.007530	1322.410	1.17E+13	-4744.686	33642.
268.800	0.641107	2.91E+08	-9.62E+05	-0.007410	1302.221	1.19E+13	-4570.334	34218.

273.600	0.605819	2.86E+08	-9.84E+05	-0.007295	1281.564	1.20E+13	-4391.471	34794.
278.400	0.571080	2.81E+08	-1.00E+06	-0.007182	1260.460	1.21E+13	-4208.180	35370.
283.200	0.536874	2.77E+08	-1.05E+06	-0.007072	1238.925	1.22E+13	-13872.	1.24E+05
288.000	0.503189	2.71E+08	-1.11E+06	-0.006965	1215.974	1.23E+13	-13949.	1.33E+05
292.800	0.470011	2.66E+08	-1.18E+06	-0.006860	1191.600	1.23E+13	-13994.	1.43E+05
297.600	0.437330	2.60E+08	-1.25E+06	-0.006758	1165.797	1.24E+13	-14020.	1.54E+05
302.400	0.405133	2.54E+08	-1.32E+06	-0.006658	1138.564	1.24E+13	-14033.	1.66E+05
307.200	0.373409	2.47E+08	-1.38E+06	-0.006561	1109.898	1.24E+13	-14007.	1.80E+05
312.000	0.342146	2.41E+08	-1.45E+06	-0.006467	1079.802	1.24E+13	-13939.	1.96E+05
316.800	0.311331	2.34E+08	-1.52E+06	-0.006375	1048.284	1.24E+13	-13825.	2.13E+05
321.600	0.280949	2.26E+08	-1.58E+06	-0.006286	1015.354	1.24E+13	-13660.	2.33E+05
326.400	0.250988	2.18E+08	-1.65E+06	-0.006200	931.031	1.24E+13	-12922.	2.47E+05
331.200	0.221431	2.10E+08	-1.71E+06	-0.006117	945.389	1.24E+13	-11640.	2.52E+05
336.000	0.192265	2.02E+08	-1.76E+06	-0.006037	908.558	1.24E+13	-10314.	2.58E+05
340.800	0.163473	1.93E+08	-1.80E+06	-0.005961	870.675	1.25E+13	-8946.232	2.63E+05
345.600	0.135039	1.85E+08	-1.84E+06	-0.005888	831.879	1.25E+13	-7535.980	2.68E+05
350.400	0.106946	1.76E+08	-1.88E+06	-0.005819	792.313	1.25E+13	-6083.736	2.73E+05
355.200	0.079178	1.67E+08	-1.90E+06	-0.005753	752.126	1.25E+13	-4589.634	2.78E+05
360.000	0.051717	1.58E+08	-1.92E+06	-0.005691	711.471	1.25E+13	-3053.717	2.83E+05
364.800	0.024548	1.48E+08	-1.93E+06	-0.005632	670.504	1.25E+13	-1475.948	2.89E+05
369.600	-0.002349	1.39E+08	-1.93E+06	-0.005577	629.386	1.25E+13	143.791	2.94E+05
374.400	-0.028990	1.30E+08	-1.93E+06	-0.005525	588.283	1.25E+13	1805.694	2.99E+05
379.200	-0.055393	1.20E+08	-1.92E+06	-0.005496	547.363	5.94E+13	3510.030	3.04E+05
384.000	-0.081749	1.11E+08	-1.90E+06	-0.005486	506.802	5.95E+13	5268.382	3.09E+05
388.800	-0.108061	1.02E+08	-1.87E+06	-0.005478	466.779	5.96E+13	7080.838	3.15E+05
393.600	-0.134334	9.34E+07	-1.83E+06	-0.005470	427.477	5.97E+13	8947.495	3.20E+05
398.400	-0.160572	8.47E+07	-1.78E+06	-0.005463	389.089	5.98E+13	10772.	3.22E+05
403.200	-0.186776	7.63E+07	-1.72E+06	-0.005456	351.800	5.99E+13	12732.	3.27E+05
408.000	-0.212951	6.82E+07	-1.66E+06	-0.005450	315.810	5.99E+13	14746.	3.32E+05
412.800	-0.239100	6.04E+07	-1.58E+06	-0.005445	281.324	6.00E+13	16747.	3.36E+05
417.600	-0.265225	5.30E+07	-1.50E+06	-0.005441	248.548	6.01E+13	17491.	3.17E+05
422.400	-0.291331	4.60E+07	-1.42E+06	-0.005437	217.556	6.02E+13	18199.	3.00E+05
427.200	-0.317419	3.94E+07	-1.33E+06	-0.005433	188.421	6.02E+13	18876.	2.85E+05
432.000	-0.343491	3.33E+07	-1.23E+06	-0.005430	161.212	6.03E+13	19528.	2.73E+05
436.800	-0.369551	2.76E+07	-1.14E+06	-0.005428	135.996	6.04E+13	20163.	2.62E+05
441.600	-0.395601	2.23E+07	-1.04E+06	-0.005426	112.837	6.04E+13	20778.	2.52E+05
446.400	-0.421642	1.76E+07	-9.39E+05	-0.005424	91.798	6.04E+13	21375.	2.43E+05
451.200	-0.447676	1.33E+07	-8.35E+05	-0.005423	72.941	6.04E+13	21955.	2.35E+05
456.000	-0.473705	9.59E+06	-7.29E+05	-0.005422	56.323	6.04E+13	22518.	2.28E+05
460.800	-0.499730	6.35E+06	-6.19E+05	-0.005422	42.003	6.04E+13	23064.	2.22E+05
465.600	-0.525753	3.65E+06	-4.90E+05	-0.005421	30.037	6.04E+13	30802.	2.81E+05
470.400	-0.551775	1.66E+06	-3.37E+05	-0.005421	21.214	6.04E+13	32922.	2.86E+05
475.200	-0.577796	4.25E+05	-1.74E+05	-0.005421	15.749	6.04E+13	35099.	2.92E+05
480.000	-0.603817	0.000	0.000	-0.005421	13.867	6.04E+13	37332.	1.48E+05

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection            =     4.26865070 in
Computed slope at pile head     =    -0.02076366
Maximum bending moment          =   3.686473E+08 lbs-in
Maximum shear force             =      -1934962. lbs
Depth of maximum bending moment =      110.40000 in
Depth of maximum shear force    =      369.60000 in
Number of iterations            =             67
Number of zero deflection points =             1
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
```

```
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2            lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  3.20E+05 M=  3.45E+08     189766.      4.2687  3.6865E+08   -1934962.

The analysis ended normally.
```

B.7 Undrained Analysis from 2.8 in. Triaxial Test (Service)

```
===============================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

                Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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                             All Rights Reserved

===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                           Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using Undrained Strengths.lpd
Name of output file:         Drilled Shaft Analysis Using Undrained Strengths.lpo
Name of plot output file:    Drilled Shaft Analysis Using Undrained Strengths.lpp
Name of runtime file:        Drilled Shaft Analysis Using Undrained Strengths.lpr


-------------------------------------------------------------------------------
                         Time and Date of Analysis
-------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:   9:08:17


-------------------------------------------------------------------------------
                               Problem Title
-------------------------------------------------------------------------------

Drilled Shaft Analysis:  Undrained Strengths Obtained from 2.8 in. Triaxial Test


-------------------------------------------------------------------------------
                              Program Options
-------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
```

```
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments            =         100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


-------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
-------------------------------------------------------------------------------

Pile Length                               =     840.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface             =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
          in            in         in**4         Sq.in     lbs/Sq.in
-----  ---------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000    14902723.   13685.0000      3604997.
  2     840.0000     132.00000    14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.


-------------------------------------------------------------------------------
                      Soil and Rock Layering Information
-------------------------------------------------------------------------------

The soil profile is modelled using  8 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       12.000 in
Distance from top of pile to bottom of layer =       72.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is stiff clay without free water
Distance from top of pile to top of layer    =       72.000 in
Distance from top of pile to bottom of layer =      132.000 in

Layer  3 is stiff clay without free water
Distance from top of pile to top of layer    =      132.000 in
Distance from top of pile to bottom of layer =      282.000 in

Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in

Layer  5 is stiff clay without free water
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      462.000 in

Layer  6 is stiff clay without free water
Distance from top of pile to top of layer    =      462.000 in
Distance from top of pile to bottom of layer =      672.000 in

Layer  7 is stiff clay without free water
Distance from top of pile to top of layer    =      672.000 in
Distance from top of pile to bottom of layer =      723.000 in
```

```
Layer  8 is stiff clay without free water
Distance from top of pile to top of layer    =      723.000 in
Distance from top of pile to bottom of layer =     1200.000 in


(Depth of lowest layer extends  360.00 in below pile tip)
```

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 16 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.03300
10	462.00	0.03300
11	462.00	0.03500
12	672.00	0.03500
13	672.00	0.03600
14	723.00	0.03600
15	723.00	0.03500
16	1200.00	0.03500

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	3.48000	0.00	------	------
4	132.000	3.48000	0.00	------	------
5	132.000	3.48000	0.00	------	------
6	282.000	3.48000	0.00	------	------
7	282.000	9.20000	0.00	------	------
8	396.000	9.20000	0.00	------	------
9	396.000	9.20000	0.00	------	------
10	462.000	9.20000	0.00	------	------
11	462.000	17.00000	0.00	------	------
12	672.000	17.00000	0.00	------	------
13	672.000	13.00000	0.00	------	------
14	723.000	13.00000	0.00	------	------
15	723.000	17.00000	0.00	------	------
16	1200.000	17.00000	0.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult

```
-----     ----------     ----------     ----------
  1          12.000         0.0000         1.0000
  2          42.000         0.0000         1.0000
  3          42.001         1.0000         1.0000
  4        1200.000         1.0000         1.0000
```

```
--------------------------------------------------------------------------------
                              Loading Type
--------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.



--------------------------------------------------------------------------------
              Pile-head Loading and Pile-head Fixity Conditions
--------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =      221503.000 lbs
Bending moment at pile head =   235128000.000 in-lbs
Axial load at pile head     =      117367.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head
may rotate under the applied pile-head loading, but is not a free-head
(zero moment) condition.



--------------------------------------------------------------------------------
                   Output of p-y Curves at Specified Depths
--------------------------------------------------------------------------------



p-y curves are generated and printed for verification at  5 depths.

Depth      Depth Below Pile Head      Depth Below Ground Surface
 No.                in                           in
-----      ---------------------      --------------------------
  1               60.000                        48.000
  2              174.000                       162.000
  3              348.000                       336.000
  4              513.000                       501.000
  5              690.000                       678.000

Depth of ground surface below top of pile =      12.00 in



--------------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

Number of sections =  1



Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                        =     132.0000 in

Material Properties:

Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =          100
Area of Single Bar                     =      1.27000 in**2
Number of Rows of Reinforcing Bars     =           51
Area of Steel                          =      127.000 in**2
Area of Shaft                          =    13684.778 in**2
```

```
Percentage of Steel Reinforcement      =        0.928 percent
Cover Thickness (edge to bar center)   =        4.000 in

Unfactored Axial Squash Load Capacity  =     53716.45 kip

Distribution and Area of Steel Reinforcement
```

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.270	62.000
2	2.540	61.878
3	2.540	61.511
4	2.540	60.902
5	2.540	60.052
6	2.540	58.966
7	2.540	57.646
8	2.540	56.099
9	2.540	54.331
10	2.540	52.348
11	2.540	50.159
12	2.540	47.772
13	2.540	45.196
14	2.540	42.442
15	2.540	39.520
16	2.540	36.443
17	2.540	33.221
18	2.540	29.869
19	2.540	26.398
20	2.540	22.824
21	2.540	19.159
22	2.540	15.419
23	2.540	11.618
24	2.540	7.771
25	2.540	3.893
26	2.540	0.000
27	2.540	-3.893
28	2.540	-7.771
29	2.540	-11.618
30	2.540	-15.419
31	2.540	-19.159
32	2.540	-22.824
33	2.540	-26.398
34	2.540	-29.869
35	2.540	-33.221
36	2.540	-36.443
37	2.540	-39.520
38	2.540	-42.442
39	2.540	-45.196
40	2.540	-47.772
41	2.540	-50.159
42	2.540	-52.348
43	2.540	-54.331
44	2.540	-56.099
45	2.540	-57.646
46	2.540	-58.966
47	2.540	-60.052
48	2.540	-60.902
49	2.540	-61.511
50	2.540	-61.878
51	1.270	-62.000

```
Axial Thrust Force =         0.00  lbs
```

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25476354.	6.114325E+13	4.166667E-07	0.00002759	66.21587902	97.95153255	751.77520
50726322.	6.087159E+13	8.333333E-07	0.00005518	66.21542269	194.47007	1503.53938
75749906.	6.059992E+13	0.00000125	0.00008277	66.21496242	289.55565	2255.29239
1.005471E+08	6.032826E+13	0.00000167	0.00011036	66.21449822	383.20832	3007.03408
1.251179E+08	6.005660E+13	0.00000208	0.00013795	66.21403009	475.42813	3758.76432
1.251179E+08	5.004717E+13	0.00000250	0.00008208	32.83139080	282.36798	6899.72417
1.251179E+08	4.289757E+13	0.00000292	0.00009582	32.85245293	328.45176	8047.89669
1.251179E+08	3.753538E+13	0.00000333	0.00010958	32.87361342	374.25373	9195.55070
1.251179E+08	3.336478E+13	0.00000375	0.00012336	32.89486831	419.77288	10342.68307
1.251179E+08	3.002830E+13	0.00000417	0.00013715	32.91622549	465.00833	11489.28942
1.251179E+08	2.729846E+13	0.00000458	0.00015096	32.93768102	509.95903	12635.36656

1.251179E+08	2.502358E+13	0.00000500	0.00016480	32.95923489	554.62396	13780.91094
1.251179E+08	2.309869E+13	0.00000542	0.00017865	32.98088712	599.00210	14925.91898
1.251179E+08	2.144879E+13	0.00000583	0.00019250	33.00000197	643.04206	16070.83300
1.251179E+08	2.001887E+13	0.00000625	0.00020625	33.00000197	686.39668	17218.74964
1.251179E+08	1.876769E+13	0.00000667	0.00022000	33.00000197	729.40771	18366.66629
1.251179E+08	1.766371E+13	0.00000708	0.00023375	33.00000197	772.07514	19514.58293
1.251179E+08	1.668239E+13	0.00000750	0.00024755	33.00632769	814.54943	20661.12373
1.251179E+08	1.580437E+13	0.00000792	0.00026146	33.02685088	857.04776	21804.25215
1.251179E+08	1.501415E+13	0.00000833	0.00027540	33.04746455	899.24960	22946.86273
1.251179E+08	1.429919E+13	0.00000875	0.00028935	33.06817263	941.15399	24088.95119
1.253194E+08	1.367120E+13	0.00000917	0.00030332	33.08897513	982.75989	25230.51411
1.309487E+08	1.366421E+13	0.00000958	0.00031730	33.10987204	1024.06623	26371.54806
1.365720E+08	1.365720E+13	0.00001000	0.00033131	33.13086337	1065.07192	27512.04962
1.421891E+08	1.365015E+13	0.00001042	0.00034533	33.15195304	1105.77599	28652.01419
1.478001E+08	1.364308E+13	0.00001083	0.00035938	33.17314106	1146.17733	29791.43818
1.534049E+08	1.363599E+13	0.00001125	0.00037344	33.19442743	1186.27483	30930.31805
1.590035E+08	1.362887E+13	0.00001167	0.00038752	33.21581608	1226.06748	32068.64889
1.645958E+08	1.362172E+13	0.00001208	0.00040162	33.23730308	1265.55403	33206.42838
1.701818E+08	1.361454E+13	0.00001250	0.00041574	33.25889236	1304.73343	34343.65152
1.757615E+08	1.360734E+13	0.00001292	0.00042987	33.28058392	1343.60454	35480.31461
1.813348E+08	1.360011E+13	0.00001333	0.00044403	33.30237776	1382.16615	36616.41393
1.869017E+08	1.359285E+13	0.00001375	0.00045821	33.32427782	1420.41723	37751.94422
1.924622E+08	1.358556E+13	0.00001417	0.00047241	33.34628409	1458.35657	38886.90162
1.980161E+08	1.357825E+13	0.00001458	0.00048662	33.36839265	1495.98280	40021.28394
2.035636E+08	1.357091E+13	0.00001500	0.00050086	33.39061528	1533.29513	41155.08235
2.091045E+08	1.356353E+13	0.00001542	0.00051512	33.41294414	1570.29200	42288.29622
2.146388E+08	1.355613E+13	0.00001583	0.00052939	33.43538314	1606.97232	43420.91991
2.201664E+08	1.354870E+13	0.00001625	0.00054369	33.45793229	1643.33480	44552.94941
2.312016E+08	1.353375E+13	0.00001708	0.00057235	33.50336891	1715.10137	46815.20598
2.422097E+08	1.351868E+13	0.00001792	0.00060109	33.54926187	1785.58150	49075.02935
2.531904E+08	1.350349E+13	0.00001875	0.00062992	33.59562689	1854.76509	51332.37788
2.641432E+08	1.348817E+13	0.00001958	0.00065883	33.64246398	1922.64107	53587.21733
2.750680E+08	1.347272E+13	0.00002042	0.00068783	33.68978888	1989.19882	55839.50417
2.859642E+08	1.345714E+13	0.00002125	0.00071692	33.73761338	2054.42728	58089.19575
2.967232E+08	1.343652E+13	0.00002208	0.00074601	33.78144497	2118.09301	60000.00000
3.052926E+08	1.332186E+13	0.00002292	0.00077317	33.73828608	2176.02906	60000.00000
3.124730E+08	1.315676E+13	0.00002375	0.00079909	33.64578027	2229.97326	60000.00000
3.187410E+08	1.296574E+13	0.00002458	0.00082417	33.52554435	2280.95855	60000.00000
3.243247E+08	1.276031E+13	0.00002542	0.00084861	33.38796383	2329.50000	60000.00000
3.293689E+08	1.254739E+13	0.00002625	0.00087253	33.23941952	2375.93339	60000.00000
3.339510E+08	1.233050E+13	0.00002708	0.00089600	33.08319622	2420.44829	60000.00000
3.390265E+08	1.214423E+13	0.00002792	0.00092125	33.00000197	2467.36427	60000.00000
3.421665E+08	1.190144E+13	0.00002875	0.00094422	32.84229559	2508.88759	60000.00000
3.457708E+08	1.168803E+13	0.00002958	0.00096634	32.66486853	2547.92546	60000.00000
3.490333E+08	1.147507E+13	0.00003042	0.00098803	32.48322433	2585.33441	60000.00000
3.521400E+08	1.126848E+13	0.00003125	0.00100955	32.30569893	2621.60086	60000.00000
3.550246E+08	1.106570E+13	0.00003208	0.00103080	32.12880296	2656.57286	60000.00000
3.577186E+08	1.086740E+13	0.00003292	0.00105180	31.95342547	2690.33435	60000.00000
3.602788E+08	1.067493E+13	0.00003375	0.00107264	31.78199762	2723.05334	60000.00000
3.626651E+08	1.048670E+13	0.00003458	0.00109325	31.61198598	2754.62514	60000.00000
3.649275E+08	1.030384E+13	0.00003542	0.00111370	31.44555420	2785.20094	60000.00000
3.671024E+08	1.012696E+13	0.00003625	0.00113404	31.28386277	2814.87554	60000.00000
3.690935E+08	9.953084E+12	0.00003708	0.00115411	31.12201399	2843.41113	60000.00000
3.710781E+08	9.786676E+12	0.00003792	0.00117421	30.96817070	2871.28187	60000.00000
3.728888E+08	9.622938E+12	0.00003875	0.00119403	30.81374913	2898.04725	60000.00000
3.748703E+08	9.470408E+12	0.00003958	0.00121808	30.77244705	2929.84195	60000.00000
3.765709E+08	9.317218E+12	0.00004042	0.00123730	30.61348969	2954.26711	60000.00000
3.781214E+08	9.166580E+12	0.00004125	0.00125623	30.45398551	2977.67239	60000.00000
3.795985E+08	9.020163E+12	0.00004208	0.00127504	30.29793924	3000.29647	60000.00000
3.810705E+08	8.879312E+12	0.00004292	0.00129388	30.14866322	3022.33472	60000.00000
3.824793E+08	8.742383E+12	0.00004375	0.00131261	30.00261301	3043.62131	60000.00000
3.837522E+08	8.607525E+12	0.00004458	0.00133107	29.85567766	3063.96715	60000.00000
3.850203E+08	8.477511E+12	0.00004542	0.00134955	29.71478087	3083.74758	60000.00000
3.862836E+08	8.352078E+12	0.00004625	0.00136806	29.57960004	3102.95979	60000.00000
3.874732E+08	8.229519E+12	0.00004708	0.00138642	29.44603604	3121.41473	60000.00000
3.885611E+08	8.109101E+12	0.00004792	0.00140456	29.31245631	3139.05286	60000.00000
3.896445E+08	7.992708E+12	0.00004875	0.00142272	29.18403000	3156.14208	60000.00000
3.907234E+08	7.880136E+12	0.00004958	0.00144092	29.06049746	3172.67950	60000.00000
3.927391E+08	7.663203E+12	0.00005125	0.00147703	28.82004136	3203.76888	60000.00000
3.928849E+08	7.424596E+12	0.00005292	0.00151342	28.59999830	3232.79798	60000.00000
3.966872E+08	7.267552E+12	0.00005458	0.00155510	28.49045867	3263.39404	60000.00000
3.982476E+08	7.079958E+12	0.00005625	0.00158917	28.25193018	3285.88009	60000.00000
3.997207E+08	6.901653E+12	0.00005792	0.00162309	28.02449924	3306.25345	60000.00000
4.011796E+08	6.733083E+12	0.00005958	0.00165711	27.81155688	3324.68210	60000.00000
4.024870E+08	6.571216E+12	0.00006125	0.00169069	27.60316998	3340.88958	60000.00000
4.037013E+08	6.416444E+12	0.00006292	0.00172407	27.40249747	3355.04838	60000.00000
4.049021E+08	6.269452E+12	0.00006458	0.00175756	27.21378404	3367.30862	60000.00000
4.060892E+08	6.129649E+12	0.00006625	0.00179114	27.03614062	3377.65146	60000.00000
4.070893E+08	5.993952E+12	0.00006792	0.00182407	26.85745865	3385.87838	60000.00000
4.080697E+08	5.864474E+12	0.00006958	0.00185707	26.68836755	3392.23773	60000.00000
4.090370E+08	5.740870E+12	0.00007125	0.00189016	26.52863127	3396.71998	60000.00000

4.104244E+08	5.628678E+12	0.00007292	0.00192500	26.40000039	3399.38858	60000.00000
4.112162E+08	5.513513E+12	0.00007458	0.00196794	26.38583833	3395.76365	60000.00000
4.119213E+08	5.402246E+12	0.00007625	0.00199909	26.21758908	3388.01797	60000.00000
4.126212E+08	5.295674E+12	0.00007792	0.00203034	26.05779773	3390.91516	60000.00000
4.133160E+08	5.193500E+12	0.00007958	0.00206168	25.90594894	3395.12405	60000.00000
4.140054E+08	5.095451E+12	0.00008125	0.00209313	25.76156670	3398.04262	60000.00000
4.146886E+08	5.001270E+12	0.00008292	0.00212467	25.62415141	3399.65551	60000.00000
4.152413E+08	4.909256E+12	0.00008458	0.00215552	25.48392731	3398.27690	60000.00000
4.157833E+08	4.820676E+12	0.00008625	0.00218654	25.35120910	3391.53208	60000.00000
4.163220E+08	4.735417E+12	0.00008792	0.00221764	25.22439176	3384.76707	60000.00000
4.168576E+08	4.653294E+12	0.00008958	0.00224882	25.10315663	3387.41726	60000.00000
4.173898E+08	4.574134E+12	0.00009125	0.00228008	24.98720866	3391.83006	60000.00000
4.179185E+08	4.497778E+12	0.00009292	0.00231142	24.87626857	3395.30434	60000.00000
4.184053E+08	4.423668E+12	0.00009458	0.00234253	24.76681942	3397.80157	60000.00000
4.188306E+08	4.351486E+12	0.00009625	0.00237325	24.65711850	3399.34294	60000.00000
4.192528E+08	4.281731E+12	0.00009792	0.00240404	24.55194157	3399.98156	60000.00000
4.196653E+08	4.214212E+12	0.00009958	0.00243503	24.45221704	3395.38769	60000.00000
4.200742E+08	4.148881E+12	0.00010125	0.00246611	24.35663098	3389.59867	60000.00000
4.204675E+08	4.085515E+12	0.00010292	0.00249746	24.26678056	3383.73787	60000.00000
4.204675E+08	4.020407E+12	0.00010458	0.00253092	24.19999856	3379.76754	60000.00000
4.204675E+08	3.957342E+12	0.00010625	0.00257125	24.19999856	3386.74680	60000.00000
4.208985E+08	3.900217E+12	0.00010792	0.00261158	24.19999856	3392.25526	60000.00000
4.220991E+08	3.851855E+12	0.00010958	0.00264902	24.17356664	3395.93695	60000.00000
4.223088E+08	3.796034E+12	0.00011125	0.00267986	24.08860606	3397.88513	60000.00000
4.225165E+08	3.741844E+12	0.00011292	0.00271076	24.00675720	3399.20670	60000.00000
4.227224E+08	3.689214E+12	0.00011458	0.00274174	23.92789811	3399.89447	60000.00000
4.229109E+08	3.637944E+12	0.00011625	0.00277318	23.85535294	3397.83583	60000.00000
4.232583E+08	3.539442E+12	0.00011958	0.00283693	23.72342151	3387.77541	60000.00000
4.236011E+08	3.446246E+12	0.00012292	0.00290087	23.60030991	3377.66094	60000.00000
4.239317E+08	3.357875E+12	0.00012625	0.00296524	23.48701340	3376.78559	60000.00000
4.241783E+08	3.273401E+12	0.00012958	0.00302982	23.38123852	3385.30625	60000.00000
4.243690E+08	3.192745E+12	0.00013292	0.00309369	23.27543217	3391.76040	60000.00000
4.245551E+08	3.116001E+12	0.00013625	0.00315779	23.17645901	3396.38750	60000.00000
4.247363E+08	3.042887E+12	0.00013958	0.00322212	23.08387452	3399.14698	60000.00000
4.248910E+08	2.972998E+12	0.00014292	0.00328743	23.00242692	3399.29031	60000.00000
4.250180E+08	2.906106E+12	0.00014625	0.00335380	22.93198639	3390.47219	60000.00000
4.251422E+08	2.842176E+12	0.00014958	0.00342034	22.86578268	3381.61069	60000.00000
4.252636E+08	2.781015E+12	0.00015292	0.00348705	22.80356795	3372.70463	60000.00000
4.253552E+08	2.722273E+12	0.00015625	0.00355321	22.74055463	3363.94114	60000.00000
4.254075E+08	2.665739E+12	0.00015958	0.00361857	22.67509049	3367.69721	60000.00000
4.254557E+08	2.611493E+12	0.00016292	0.00368415	22.61370975	3376.02769	60000.00000
4.254777E+08	2.559265E+12	0.00016625	0.00375091	22.56188840	3383.41921	60000.00000
4.254968E+08	2.509072E+12	0.00016958	0.00381787	22.51322991	3389.49075	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 424064.41017 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number	=	1	
Depth below pile head	=	60.000	in
Depth below ground surface	=	48.000	in
Equivalent Depth (see note)	=	48.000	in
Pile Diameter	=	132.000	in
Angle of Friction	=	46.000	deg.
Avg. Eff. Unit Weight	=	0.05300	pci
k	=	225.000	pci
A (static)	=	2.5755	
B (static)	=	1.9145	
Pst	=	2979.144	lbs/in
Psd	=	82368.160	lbs/in
Ps	=	2979.144	lbs/in
Cbar	=	4587.6751	
n	=	3.6210	
m	=	715.9795	
yk	=	0.3064	in
pm	=	5703.707	lbs/in
ym	=	2.2000	in
pu	=	7672.651	lbs/in
yu	=	4.9500	in
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in
0.0000	0.0000
0.1833333	1980.0000

```
      0.3666667        3477.4460
      0.5500000        3889.4693
      0.7333333        4211.0834
      0.9166667        4478.7502
         1.1000        4710.0313
         1.2833        4914.8701
         1.4667        5099.4965
         1.6500        5268.0968
         1.8333        5423.6329
         2.0167        5568.2847
         2.2000        5703.7075
         3.5750        6688.1793
         4.9500        7672.6512
       136.9500        7672.6512
       268.9500        7672.6512

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.
```

```
p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number             =          3
Depth below pile head         =      174.000 in
Depth below ground surface    =      162.000 in
Equivalent Depth              =      231.381 in
Diameter                      =      132.000 in
Undrained cohesion, c         =      3.48000 lbs/in**2
Average Eff. Unit Weight      =      0.06404 lbs/in**3
Epsilon-50                    =      0.01100
Pct                           =     3736.521 lbs/in
Pcd                           =     4134.240 lbs/in
Pu                            =     3736.521 lbs/in
y50                           =        3.630 in
p-multiplier                  =      1.00000
y-multiplier                  =      1.00000

        y, in            p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.0005808         210.1200
      0.0029040         314.2027
      0.0058080         373.6521
      0.0290400         558.7402
      0.0580800         664.4578
      0.2904000         993.5962
      0.5808000        1181.5916
         1.4520        1485.7728
         2.9040        1766.8916
         4.3560        1955.3870
         5.8080        2101.2001
        14.5200        2642.1193
        29.0400        3142.0270
        58.0800        3736.5209
        65.3400        3736.5209
        72.6000        3736.5209
```

```
p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number             =          4
Depth below pile head         =      348.000 in
Depth below ground surface    =      336.000 in
Equivalent Depth              =      270.291 in
Diameter                      =      132.000 in
Undrained cohesion, c         =      9.20000 lbs/in**2
Average Eff. Unit Weight      =      0.06616 lbs/in**3
Epsilon-50                    =      0.00700
Pct                           =     7247.048 lbs/in
Pcd                           =    10929.600 lbs/in
Pu                            =     7247.048 lbs/in
y50                           =        2.310 in
p-multiplier                  =      1.00000
```

```
y-multiplier               =      1.00000

        y, in            p, lbs/in
----------------    -----------------
          0.0000          0.0000
       0.0003696        407.5314
       0.0018480        609.4016
       0.0036960        724.7047
       0.0184800       1083.6864
       0.0369600       1288.7276
       0.1848000       1927.0971
       0.3696000       2291.7176
       0.9240000       2881.6824
          1.8480       3426.9172
          2.7720       3792.5073
          3.6960       4075.3143
          9.2400       5124.4364
         18.4800       6094.0163
         36.9600       7247.0475
         41.5800       7247.0475
         46.2000       7247.0475
```

```
p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =          6
Depth below pile head      =      513.000 in
Depth below ground surface =      501.000 in
Equivalent Depth           =      358.732 in
Diameter                   =      132.000 in
Undrained cohesion, c      =     17.00000 lbs/in**2
Average Eff. Unit Weight   =      0.05899 lbs/in**3
Epsilon-50                 =      0.00500
Pct                        =    12574.459 lbs/in
Pcd                        =    20196.000 lbs/in
Pu                         =    12574.459 lbs/in
y50                        =        1.650 in
p-multiplier               =      1.00000
y-multiplier               =      1.00000

        y, in            p, lbs/in
----------------    -----------------
          0.0000          0.0000
       0.0002640        707.1138
       0.0013200       1057.3817
       0.0026400       1257.4459
       0.0132000       1880.3202
       0.0264000       2236.0902
       0.1320000       3343.7347
       0.2640000       3976.3930
       0.6600000       5000.0496
          1.3200       5946.0945
          1.9800       6580.4354
          2.6400       7071.1379
          6.6000       8891.4852
         13.2000      10573.8175
         26.4000      12574.4590
         29.7000      12574.4590
         33.0000      12574.4590
```

```
p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =          7
Depth below pile head      =      690.000 in
Depth below ground surface =      678.000 in
Equivalent Depth           =      540.066 in
Diameter                   =      132.000 in
Undrained cohesion, c      =     13.00000 lbs/in**2
Average Eff. Unit Weight   =      0.05275 lbs/in**3
Epsilon-50                 =      0.00700
Pct                        =    12419.062 lbs/in
Pcd                        =    15444.000 lbs/in
Pu                         =    12419.062 lbs/in
y50                        =        2.310 in
```

```
p-multiplier                 =       1.00000
y-multiplier                 =       1.00000
```

y, in	p, lbs/in
0.0000	0.0000
0.0003696	698.3752
0.0018480	1044.3145
0.0036960	1241.9062
0.0184800	1857.0830
0.0369600	2208.4563
0.1848000	3302.4124
0.3696000	3927.2523
0.9240000	4938.2584
1.8480	5872.6120
2.7720	6499.1135
3.6960	6983.7519
9.2400	8781.6031
18.4800	10443.1449
36.9600	12419.0622
41.5800	12419.0622
46.2000	12419.0622

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

```
Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head  =      221503.000 lbs
Specified moment at pile head       =   235128000.000 in-lbs
Specified axial load at pile head   =      117367.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	2.337	2.35E+08	2.22E+05	-0.009112	1049.893	1.35E+13	0.000	0.000
8.400	2.261	2.37E+08	2.22E+05	-0.008965	1058.172	1.35E+13	0.000	0.000
16.800	2.187	2.39E+08	2.22E+05	-0.008817	1066.451	1.35E+13	0.000	0.000
25.200	2.113	2.41E+08	2.22E+05	-0.008668	1074.730	1.35E+13	0.000	0.000
33.600	2.041	2.43E+08	2.22E+05	-0.008518	1083.007	1.35E+13	0.000	0.000
42.000	1.970	2.44E+08	2.22E+05	-0.008367	1091.284	1.35E+13	0.000	0.000
50.400	1.901	2.46E+08	2.04E+05	-0.008214	1099.561	1.35E+13	-4193.798	18535.
58.800	1.832	2.48E+08	1.64E+05	-0.008061	1106.526	1.35E+13	-5259.739	24114.
67.200	1.765	2.49E+08	1.15E+05	-0.007906	1111.847	1.35E+13	-6357.054	30252.
75.600	1.699	2.50E+08	84129.	-0.007751	1115.181	1.35E+13	-1086.880	5372.396
84.000	1.635	2.51E+08	74840.	-0.007595	1118.174	1.35E+13	-1124.738	5778.702
92.400	1.572	2.51E+08	65246.	-0.007439	1120.815	1.35E+13	-1159.659	6197.487
100.800	1.510	2.52E+08	55368.	-0.007283	1123.093	1.35E+13	-1192.220	6632.418
109.200	1.449	2.52E+08	45225.	-0.007126	1124.998	1.35E+13	-1222.792	7086.525
117.600	1.390	2.52E+08	34832.	-0.006969	1126.520	1.35E+13	-1251.626	7562.521
126.000	1.332	2.53E+08	24204.	-0.006812	1127.651	1.35E+13	-1278.893	8062.984
134.400	1.276	2.53E+08	13483.	-0.006655	1128.381	1.35E+13	-1273.751	8386.603
142.800	1.221	2.53E+08	2696.604	-0.006498	1128.712	1.35E+13	-1294.461	8908.714
151.200	1.167	2.53E+08	-8259.582	-0.006340	1128.638	1.35E+13	-1314.155	9462.270
159.600	1.114	2.53E+08	-19377.	-0.006183	1128.153	1.35E+13	-1332.840	10050.
168.000	1.063	2.53E+08	-30647.	-0.006026	1127.251	1.35E+13	-1350.519	10675.
176.400	1.013	2.52E+08	-42061.	-0.005869	1125.925	1.35E+13	-1367.191	11339.
184.800	0.964148	2.52E+08	-53612.	-0.005712	1124.172	1.35E+13	-1382.850	12048.
193.200	0.916824	2.51E+08	-65289.	-0.005556	1121.986	1.35E+13	-1397.491	12804.
201.600	0.870813	2.51E+08	-77085.	-0.005399	1119.363	1.35E+13	-1411.105	13612.
210.000	0.826113	2.50E+08	-88991.	-0.005244	1116.298	1.35E+13	-1423.680	14476.
218.400	0.782720	2.49E+08	-1.01E+05	-0.005088	1112.788	1.35E+13	-1408.612	15117.
226.800	0.740628	2.48E+08	-1.13E+05	-0.004934	1108.836	1.35E+13	-1389.280	15757.
235.200	0.699835	2.47E+08	-1.24E+05	-0.004779	1104.450	1.35E+13	-1369.742	16441.
243.600	0.660333	2.46E+08	-1.36E+05	-0.004626	1099.635	1.35E+13	-1349.990	17173.
252.000	0.622118	2.45E+08	-1.47E+05	-0.004473	1094.398	1.35E+13	-1330.020	17958.
260.400	0.585183	2.44E+08	-1.58E+05	-0.004321	1088.744	1.35E+13	-1309.824	18802.
268.800	0.549521	2.43E+08	-1.69E+05	-0.004170	1082.681	1.35E+13	-1289.396	19710.
277.200	0.515126	2.41E+08	-1.80E+05	-0.004020	1076.214	1.35E+13	-1268.728	20689.
285.600	0.481988	2.40E+08	-1.94E+05	-0.003871	1069.349	1.35E+13	-2159.723	37639.
294.000	0.450100	2.38E+08	-2.12E+05	-0.003722	1061.809	1.35E+13	-2161.295	40335.
302.400	0.419453	2.36E+08	-2.30E+05	-0.003575	1053.593	1.35E+13	-2161.097	43278.
310.800	0.390037	2.34E+08	-2.48E+05	-0.003429	1044.702	1.35E+13	-2159.084	46499.
319.200	0.361841	2.32E+08	-2.67E+05	-0.003285	1035.134	1.35E+13	-2155.206	50032.
327.600	0.334853	2.29E+08	-2.85E+05	-0.003142	1024.893	1.35E+13	-2149.414	53919.

336.000	0.309062	2.27E+08	-3.03E+05	-0.003000	1013.980	1.35E+13	-2141.652	58208.
344.400	0.284453	2.24E+08	-3.21E+05	-0.002860	1002.396	1.35E+13	-2131.863	62955.
352.800	0.261014	2.22E+08	-3.39E+05	-0.002722	990.146	1.35E+13	-2119.983	68226.
361.200	0.238730	2.19E+08	-3.56E+05	-0.002585	977.233	1.36E+13	-2105.944	74100.
369.600	0.217584	2.16E+08	-3.74E+05	-0.002451	963.661	1.36E+13	-2089.672	80673.
378.000	0.197561	2.12E+08	-3.91E+05	-0.002318	949.435	1.36E+13	-2071.085	88059.
386.400	0.178644	2.09E+08	-4.09E+05	-0.002187	934.562	1.36E+13	-2050.095	96398.
394.800	0.160814	2.06E+08	-4.26E+05	-0.002059	919.047	1.36E+13	-2026.601	1.06E+05
403.200	0.144053	2.02E+08	-4.43E+05	-0.001933	902.899	1.36E+13	-1982.691	1.16E+05
411.600	0.128342	1.98E+08	-4.59E+05	-0.001809	886.130	1.36E+13	-1946.066	1.27E+05
420.000	0.113661	1.94E+08	-4.75E+05	-0.001688	868.753	1.36E+13	-1906.999	1.41E+05
428.400	0.099989	1.90E+08	-4.91E+05	-0.001569	850.779	1.36E+13	-1865.354	1.57E+05
436.800	0.087304	1.86E+08	-5.07E+05	-0.001453	832.222	1.36E+13	-1820.973	1.75E+05
445.200	0.075584	1.82E+08	-5.22E+05	-0.001339	813.096	1.36E+13	-1773.669	1.97E+05
453.600	0.064807	1.77E+08	-5.36E+05	-0.001228	793.414	1.36E+13	-1723.215	2.23E+05
462.000	0.054950	1.73E+08	-5.52E+05	-0.001120	773.194	1.36E+13	-1906.733	2.91E+05
470.400	0.045987	1.68E+08	-5.70E+05	-0.001015	752.377	1.36E+13	-2446.308	4.47E+05
478.800	0.037894	1.63E+08	-5.90E+05	-0.000913	730.796	1.36E+13	-2353.965	5.22E+05
487.200	0.030646	1.58E+08	-6.09E+05	-0.000814	708.478	1.36E+13	-2254.262	6.18E+05
495.600	0.024216	1.53E+08	-6.28E+05	-0.000718	685.456	1.36E+13	-2146.066	7.44E+05
504.000	0.018577	1.47E+08	-6.45E+05	-0.000626	661.763	1.36E+13	-2027.795	9.17E+05
512.400	0.013701	1.42E+08	-6.62E+05	-0.000537	637.435	1.37E+13	-1897.106	1.16E+06
520.800	0.009558	1.36E+08	-6.77E+05	-0.000451	612.514	1.37E+13	-1750.262	1.54E+06
529.200	0.006121	1.31E+08	-6.91E+05	-0.000369	587.046	1.37E+13	-1580.554	2.17E+06
537.600	0.003357	1.25E+08	-7.04E+05	-0.000320	561.084	5.84E+13	-1373.424	3.44E+06
546.000	0.000745	1.19E+08	-7.11E+05	-0.000303	534.693	6.01E+13	-367.715	4.15E+06
554.400	-0.001729	1.13E+08	-7.09E+05	-0.000287	508.186	6.02E+13	861.122	4.18E+06
562.800	-0.004070	1.07E+08	-6.99E+05	-0.000271	481.949	6.02E+13	1477.233	3.05E+06
571.200	-0.006285	1.01E+08	-6.86E+05	-0.000257	456.173	6.03E+13	1661.785	2.22E+06
579.600	-0.008383	9.54E+07	-6.71E+05	-0.000243	430.916	6.04E+13	1801.600	1.81E+06
588.000	-0.010369	8.98E+07	-6.56E+05	-0.000230	406.222	6.04E+13	1916.446	1.55E+06
596.400	-0.012250	8.43E+07	-6.39E+05	-0.000218	382.127	6.05E+13	2015.124	1.38E+06
604.800	-0.014033	7.90E+07	-6.22E+05	-0.000207	358.662	6.06E+13	2102.395	1.26E+06
613.200	-0.015724	7.39E+07	-6.04E+05	-0.000196	335.854	6.06E+13	2181.154	1.17E+06
621.600	-0.017329	6.89E+07	-5.85E+05	-0.000186	313.727	6.07E+13	2253.310	1.09E+06
630.000	-0.018853	6.41E+07	-5.66E+05	-0.000177	292.304	6.07E+13	2320.195	1.03E+06
638.400	-0.020303	5.94E+07	-5.46E+05	-0.000169	271.606	6.08E+13	2382.781	9.86E+05
646.800	-0.021684	5.49E+07	-5.26E+05	-0.000161	251.653	6.08E+13	2441.803	9.46E+05
655.200	-0.023002	5.06E+07	-5.05E+05	-0.000153	232.463	6.09E+13	2497.833	9.12E+05
663.600	-0.024261	4.64E+07	-4.84E+05	-0.000147	214.053	6.09E+13	2551.328	8.83E+05
672.000	-0.025466	4.24E+07	-4.63E+05	-0.000141	196.441	6.09E+13	2382.943	7.86E+05
680.400	-0.026622	3.86E+07	-4.45E+05	-0.000135	179.573	6.10E+13	2016.023	6.36E+05
688.800	-0.027733	3.49E+07	-4.28E+05	-0.000130	163.335	6.10E+13	2053.032	6.22E+05
697.200	-0.028804	3.14E+07	-4.10E+05	-0.000125	147.739	6.10E+13	2089.000	6.09E+05
705.600	-0.029838	2.80E+07	-3.93E+05	-0.000121	132.796	6.11E+13	2124.070	5.98E+05
714.000	-0.030841	2.48E+07	-3.75E+05	-0.000118	118.516	6.11E+13	2158.365	5.88E+05
722.400	-0.031814	2.18E+07	-3.57E+05	-0.000114	104.910	6.11E+13	2191.996	5.79E+05
730.800	-0.032762	1.88E+07	-3.36E+05	-0.000112	91.990	6.11E+13	2811.875	7.21E+05
739.200	-0.033689	1.61E+07	-3.12E+05	-0.000109	79.948	6.11E+13	2853.268	7.11E+05
747.600	-0.034597	1.36E+07	-2.88E+05	-0.000107	68.798	6.11E+13	2894.144	7.03E+05
756.000	-0.035489	1.13E+07	-2.63E+05	-0.000105	58.553	6.11E+13	2934.590	6.95E+05
764.400	-0.036369	9.18E+06	-2.38E+05	-0.000104	49.224	6.11E+13	2974.677	6.87E+05
772.800	-0.037238	7.28E+06	-2.13E+05	-0.000103	40.825	6.11E+13	3014.472	6.80E+05
781.200	-0.038098	5.60E+06	-1.88E+05	-0.000102	33.368	6.11E+13	3054.032	6.73E+05
789.600	-0.038952	4.13E+06	-1.62E+05	-0.000101	26.865	6.11E+13	3093.405	6.67E+05
798.000	-0.039801	2.88E+06	-1.36E+05	-0.000101	21.329	6.11E+13	3132.634	6.61E+05
806.400	-0.040647	1.85E+06	-1.09E+05	-0.000101	16.772	6.11E+13	3171.754	6.55E+05
814.800	-0.041490	1.05E+06	-82385.	-0.000100	13.206	6.11E+13	3210.794	6.50E+05
823.200	-0.042333	4.67E+05	-55250.	-0.000100	10.643	6.11E+13	3249.777	6.45E+05
831.600	-0.043175	1.17E+05	-27789.	-0.000100	9.096	6.11E+13	3288.719	6.40E+05
840.000	-0.044016	0.000	0.000	-0.000100	8.576	6.11E+13	3327.633	3.18E+05

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection            =     2.33736819 in
Computed slope at pile head     =    -0.00911160
Maximum bending moment          =   2.529254E+08 lbs-in
Maximum shear force             =  -711006.57374 lbs
Depth of maximum bending moment =      142.80000 in
Depth of maximum shear force    =      546.00000 in
```

```
Number of iterations              =           44
Number of zero deflection points  =            1



-------------------------------------------------------------------------------
                          Summary of Pile Response(s)
-------------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection   Moment      Shear
          1            2           lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  2.22E+05 M=  2.35E+08     117367.      2.3374  2.5293E+08     -711007.

The analysis ended normally.
```

B.8 Undrained Analysis from 2.8 in. Triaxial Test (Ultimate)

```
===============================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method

                       (c) 1985-2010 by Ensoft, Inc.
                            All Rights Reserved

===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                           Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using Undrained Strengths.lpd
Name of output file:         Drilled Shaft Analysis Using Undrained Strengths.lpo
Name of plot output file:    Drilled Shaft Analysis Using Undrained Strengths.lpp
Name of runtime file:        Drilled Shaft Analysis Using Undrained Strengths.lpr


-------------------------------------------------------------------------------
                          Time and Date of Analysis
-------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:   9:28:08


-------------------------------------------------------------------------------
                                Problem Title
-------------------------------------------------------------------------------

Drilled Shaft Analysis:  Undrained Strengths Obtained from 2.8 in. Triaxial Test

-------------------------------------------------------------------------------
```

Program Options

```
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments            =         100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


--------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                               =     840.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface             =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
           in           in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000    14902723.   13685.0000      3604997.
  2     840.0000     132.00000    14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  8 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       12.000 in
Distance from top of pile to bottom of layer =       72.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is stiff clay without free water
Distance from top of pile to top of layer    =       72.000 in
Distance from top of pile to bottom of layer =      132.000 in

Layer  3 is stiff clay without free water
Distance from top of pile to top of layer    =      132.000 in
Distance from top of pile to bottom of layer =      282.000 in
```

```
Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in

Layer  5 is stiff clay without free water
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      462.000 in

Layer  6 is stiff clay without free water
Distance from top of pile to top of layer    =      462.000 in
Distance from top of pile to bottom of layer =      672.000 in

Layer  7 is stiff clay without free water
Distance from top of pile to top of layer    =      672.000 in
Distance from top of pile to bottom of layer =      723.000 in

Layer  8 is stiff clay without free water
Distance from top of pile to top of layer    =      723.000 in
Distance from top of pile to bottom of layer =     1200.000 in

(Depth of lowest layer extends  360.00 in below pile tip)
```

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 16 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.03300
10	462.00	0.03300
11	462.00	0.03500
12	672.00	0.03500
13	672.00	0.03600
14	723.00	0.03600
15	723.00	0.03500
16	1200.00	0.03500

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	3.48000	0.00	------	------
4	132.000	3.48000	0.00	------	------
5	132.000	3.48000	0.00	------	------
6	282.000	3.48000	0.00	------	------
7	282.000	9.20000	0.00	------	------
8	396.000	9.20000	0.00	------	------
9	396.000	9.20000	0.00	------	------
10	462.000	9.20000	0.00	------	------
11	462.000	17.00000	0.00	------	------
12	672.000	17.00000	0.00	------	------
13	672.000	13.00000	0.00	------	------
14	723.000	13.00000	0.00	------	------
15	723.000	17.00000	0.00	------	------
16	1200.000	17.00000	0.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.

(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.001	1.0000	1.0000
4	1200.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 319693.000 lbs
Bending moment at pile head = 345051000.000 in-lbs
Axial load at pile head = 189766.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Output of p-y Curves at Specified Depths

---

p-y curves are generated and printed for verification at 5 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	48.000
2	174.000	162.000
3	348.000	336.000
4	513.000	501.000
5	690.000	678.000

Depth of ground surface below top of pile = 12.00 in

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Number of sections = 1

Pile Section No. 1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter = 132.0000 in

Material Properties:

Compressive Strength of Concrete	=	4.000 kip/in**2
Yield Stress of Reinforcement	=	60. kip/in**2
Modulus of Elasticity of Reinforcement	=	29000. kip/in**2
Number of Reinforcing Bars	=	100
Area of Single Bar	=	1.27000 in**2
Number of Rows of Reinforcing Bars	=	51
Area of Steel	=	127.000 in**2
Area of Shaft	=	13684.778 in**2
Percentage of Steel Reinforcement	=	0.928 percent
Cover Thickness (edge to bar center)	=	4.000 in

Unfactored Axial Squash Load Capacity = 53716.45 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.270	62.000
2	2.540	61.878
3	2.540	61.511
4	2.540	60.902
5	2.540	60.052
6	2.540	58.966
7	2.540	57.646
8	2.540	56.099
9	2.540	54.331
10	2.540	52.348
11	2.540	50.159
12	2.540	47.772
13	2.540	45.196
14	2.540	42.442
15	2.540	39.520
16	2.540	36.443
17	2.540	33.221
18	2.540	29.869
19	2.540	26.398
20	2.540	22.824
21	2.540	19.159
22	2.540	15.419
23	2.540	11.618
24	2.540	7.771
25	2.540	3.893
26	2.540	0.000
27	2.540	-3.893
28	2.540	-7.771
29	2.540	-11.618
30	2.540	-15.419
31	2.540	-19.159
32	2.540	-22.824
33	2.540	-26.398
34	2.540	-29.869
35	2.540	-33.221
36	2.540	-36.443
37	2.540	-39.520
38	2.540	-42.442
39	2.540	-45.196
40	2.540	-47.772
41	2.540	-50.159
42	2.540	-52.348
43	2.540	-54.331
44	2.540	-56.099
45	2.540	-57.646
46	2.540	-58.966
47	2.540	-60.052
48	2.540	-60.902
49	2.540	-61.511
50	2.540	-61.878
51	1.270	-62.000

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25476354.	6.114325E+13	4.166667E-07	0.00002759	66.21587902	97.95153255	751.77520
50726322.	6.087159E+13	8.333333E-07	0.00005518	66.21542269	194.47007	1503.53938
75749906.	6.059992E+13	0.00000125	0.00008277	66.21496242	289.55565	2255.29239
1.005471E+08	6.032826E+13	0.00000167	0.00011036	66.21449822	383.20832	3007.03408
1.251179E+08	6.005660E+13	0.00000208	0.00013795	66.21403009	475.42813	3758.76432
1.251179E+08	5.004717E+13	0.00000250	0.00008208	32.83139080	282.36798	6899.72417
1.251179E+08	4.289757E+13	0.00000292	0.00009582	32.85245293	328.45176	8047.89669
1.251179E+08	3.753538E+13	0.00000333	0.00010958	32.87361342	374.25373	9195.55070
1.251179E+08	3.336478E+13	0.00000375	0.00012336	32.89486831	419.77288	10342.68307
1.251179E+08	3.002830E+13	0.00000417	0.00013715	32.91622549	465.00833	11489.28942
1.251179E+08	2.729846E+13	0.00000458	0.00015096	32.93768102	509.95903	12635.36656
1.251179E+08	2.502358E+13	0.00000500	0.00016480	32.95923489	554.62396	13780.91094
1.251179E+08	2.309869E+13	0.00000542	0.00017865	32.98088712	599.00210	14925.91898
1.251179E+08	2.144879E+13	0.00000583	0.00019250	33.00000197	643.04206	16070.83300
1.251179E+08	2.001887E+13	0.00000625	0.00020625	33.00000197	686.39668	17218.74964
1.251179E+08	1.876769E+13	0.00000667	0.00022000	33.00000197	729.40771	18366.66629
1.251179E+08	1.766371E+13	0.00000708	0.00023375	33.00000197	772.07514	19514.58293
1.251179E+08	1.668239E+13	0.00000750	0.00024755	33.00632769	814.54943	20661.12373
1.251179E+08	1.580437E+13	0.00000792	0.00026146	33.02685088	857.04776	21804.25215
1.251179E+08	1.501415E+13	0.00000833	0.00027540	33.04746455	899.24960	22946.86273
1.251179E+08	1.429919E+13	0.00000875	0.00028935	33.06817263	941.15399	24088.95119
1.253194E+08	1.367120E+13	0.00000917	0.00030332	33.08897513	982.75989	25230.51411
1.309487E+08	1.366421E+13	0.00000958	0.00031730	33.10987204	1024.06623	26371.54806
1.365720E+08	1.365720E+13	0.00001000	0.00033131	33.13086337	1065.07192	27512.04962
1.421891E+08	1.365015E+13	0.00001042	0.00034533	33.15195304	1105.77599	28652.01419
1.478001E+08	1.364308E+13	0.00001083	0.00035938	33.17314106	1146.17733	29791.43818
1.534049E+08	1.363599E+13	0.00001125	0.00037344	33.19442743	1186.27483	30930.31805
1.590035E+08	1.362887E+13	0.00001167	0.00038752	33.21581608	1226.06748	32068.64889
1.645958E+08	1.362172E+13	0.00001208	0.00040162	33.23730308	1265.55403	33206.42838
1.701818E+08	1.361454E+13	0.00001250	0.00041574	33.25889236	1304.73343	34343.65152
1.757615E+08	1.360734E+13	0.00001292	0.00042987	33.28058392	1343.60454	35480.31461
1.813348E+08	1.360011E+13	0.00001333	0.00044403	33.30237776	1382.16615	36616.41393
1.869017E+08	1.359285E+13	0.00001375	0.00045821	33.32427782	1420.41723	37751.94422
1.924622E+08	1.358556E+13	0.00001417	0.00047241	33.34628409	1458.35657	38886.90162
1.980161E+08	1.357825E+13	0.00001458	0.00048662	33.36839265	1495.98280	40021.28394
2.035636E+08	1.357091E+13	0.00001500	0.00050086	33.39061528	1533.29513	41155.08235
2.091045E+08	1.356353E+13	0.00001542	0.00051512	33.41294414	1570.29200	42288.29622
2.146388E+08	1.355613E+13	0.00001583	0.00052939	33.43538314	1606.97232	43420.91991
2.201664E+08	1.354870E+13	0.00001625	0.00054369	33.45793229	1643.33480	44552.94941
2.312016E+08	1.353375E+13	0.00001708	0.00057235	33.50336891	1715.10137	46815.20598
2.422097E+08	1.351868E+13	0.00001792	0.00060109	33.54926187	1785.58150	49075.02935
2.531904E+08	1.350349E+13	0.00001875	0.00062992	33.59562689	1854.76509	51332.37788
2.641432E+08	1.348817E+13	0.00001958	0.00065883	33.64246398	1922.64107	53587.21733
2.750680E+08	1.347272E+13	0.00002042	0.00068783	33.68978888	1989.19882	55839.50417
2.859642E+08	1.345714E+13	0.00002125	0.00071692	33.73761338	2054.42728	58089.19575
2.967232E+08	1.343652E+13	0.00002208	0.00074601	33.78144497	2118.09301	60000.00000
3.052926E+08	1.332186E+13	0.00002292	0.00077317	33.73828608	2176.02906	60000.00000
3.124730E+08	1.315676E+13	0.00002375	0.00079909	33.64578027	2229.97326	60000.00000
3.187410E+08	1.296574E+13	0.00002458	0.00082417	33.52554435	2280.95855	60000.00000
3.243247E+08	1.276031E+13	0.00002542	0.00084861	33.38796383	2329.50000	60000.00000
3.293689E+08	1.254739E+13	0.00002625	0.00087253	33.23941952	2375.93339	60000.00000
3.339510E+08	1.233050E+13	0.00002708	0.00089600	33.08319622	2420.44829	60000.00000
3.390265E+08	1.214423E+13	0.00002792	0.00092125	33.00000197	2467.36427	60000.00000
3.421665E+08	1.190144E+13	0.00002875	0.00094422	32.84229559	2508.88759	60000.00000
3.457708E+08	1.168803E+13	0.00002958	0.00096634	32.66486853	2547.92546	60000.00000
3.490333E+08	1.147507E+13	0.00003042	0.00098803	32.48322433	2585.33441	60000.00000
3.521400E+08	1.126848E+13	0.00003125	0.00100955	32.30569893	2621.60086	60000.00000
3.550246E+08	1.106570E+13	0.00003208	0.00103080	32.12880296	2656.57286	60000.00000
3.577186E+08	1.086740E+13	0.00003292	0.00105180	31.95342547	2690.33435	60000.00000
3.602788E+08	1.067493E+13	0.00003375	0.00107264	31.78199762	2723.05334	60000.00000
3.626651E+08	1.048670E+13	0.00003458	0.00109325	31.61198598	2754.62514	60000.00000
3.649275E+08	1.030384E+13	0.00003542	0.00111370	31.44555420	2785.20094	60000.00000
3.671024E+08	1.012696E+13	0.00003625	0.00113404	31.28386277	2814.87554	60000.00000
3.690935E+08	9.953084E+12	0.00003708	0.00115411	31.12201399	2843.41113	60000.00000
3.710781E+08	9.786676E+12	0.00003792	0.00117421	30.96817070	2871.28187	60000.00000
3.728888E+08	9.622938E+12	0.00003875	0.00119403	30.81374913	2898.04725	60000.00000
3.748703E+08	9.470408E+12	0.00003958	0.00121808	30.77244705	2929.84195	60000.00000
3.765709E+08	9.317218E+12	0.00004042	0.00123730	30.61348969	2954.26711	60000.00000
3.781214E+08	9.166580E+12	0.00004125	0.00125623	30.45398551	2977.67239	60000.00000
3.795985E+08	9.020163E+12	0.00004208	0.00127504	30.29793924	3000.29647	60000.00000
3.810705E+08	8.879312E+12	0.00004292	0.00129388	30.14866322	3022.33472	60000.00000
3.824793E+08	8.742383E+12	0.00004375	0.00131261	30.00261301	3043.62131	60000.00000
3.837522E+08	8.607525E+12	0.00004458	0.00133107	29.85567766	3063.96715	60000.00000
3.850203E+08	8.477511E+12	0.00004542	0.00134955	29.71478087	3083.74758	60000.00000
3.862836E+08	8.352078E+12	0.00004625	0.00136806	29.57960004	3102.95979	60000.00000
3.874732E+08	8.229519E+12	0.00004708	0.00138642	29.44603604	3121.41473	60000.00000
3.885611E+08	8.109101E+12	0.00004792	0.00140456	29.31245631	3139.05286	60000.00000

3.896445E+08	7.992708E+12	0.00004875	0.00142272	29.18403000	3156.14208	60000.00000
3.907234E+08	7.880136E+12	0.00004958	0.00144092	29.06049746	3172.67950	60000.00000
3.927391E+08	7.663203E+12	0.00005125	0.00147703	28.82004136	3203.76888	60000.00000
3.928849E+08	7.424596E+12	0.00005292	0.00151342	28.59999830	3232.79798	60000.00000
3.966872E+08	7.267552E+12	0.00005458	0.00155510	28.49045867	3263.39404	60000.00000
3.982476E+08	7.079958E+12	0.00005625	0.00158917	28.25193018	3285.88009	60000.00000
3.997207E+08	6.901653E+12	0.00005792	0.00162309	28.02449924	3306.25345	60000.00000
4.011796E+08	6.733083E+12	0.00005958	0.00165711	27.81155688	3324.68210	60000.00000
4.024870E+08	6.571216E+12	0.00006125	0.00169069	27.60316998	3340.88958	60000.00000
4.037013E+08	6.416444E+12	0.00006292	0.00172407	27.40249747	3355.04838	60000.00000
4.049021E+08	6.269452E+12	0.00006458	0.00175756	27.21378404	3367.30862	60000.00000
4.060892E+08	6.129649E+12	0.00006625	0.00179114	27.03614062	3377.65146	60000.00000
4.070893E+08	5.993952E+12	0.00006792	0.00182407	26.85745865	3385.87838	60000.00000
4.080697E+08	5.864474E+12	0.00006958	0.00185707	26.68836755	3392.23773	60000.00000
4.090370E+08	5.740870E+12	0.00007125	0.00189016	26.52863127	3396.71998	60000.00000
4.104244E+08	5.628678E+12	0.00007292	0.00192500	26.40000039	3399.38858	60000.00000
4.112162E+08	5.513513E+12	0.00007458	0.00196794	26.38583833	3395.76365	60000.00000
4.119213E+08	5.402246E+12	0.00007625	0.00199909	26.21758908	3388.01797	60000.00000
4.126212E+08	5.295674E+12	0.00007792	0.00203034	26.05779773	3390.91516	60000.00000
4.133160E+08	5.193500E+12	0.00007958	0.00206168	25.90594894	3395.12405	60000.00000
4.140054E+08	5.095451E+12	0.00008125	0.00209313	25.76156670	3398.04262	60000.00000
4.146886E+08	5.001270E+12	0.00008292	0.00212467	25.62415141	3399.65551	60000.00000
4.152413E+08	4.909256E+12	0.00008458	0.00215552	25.48392731	3398.27690	60000.00000
4.157833E+08	4.820676E+12	0.00008625	0.00218654	25.35120910	3391.53208	60000.00000
4.163220E+08	4.735417E+12	0.00008792	0.00221764	25.22439176	3384.76707	60000.00000
4.168576E+08	4.653294E+12	0.00008958	0.00224882	25.10315663	3387.41726	60000.00000
4.173898E+08	4.574134E+12	0.00009125	0.00228008	24.98720866	3391.83006	60000.00000
4.179185E+08	4.497778E+12	0.00009292	0.00231142	24.87626857	3395.30434	60000.00000
4.184053E+08	4.423668E+12	0.00009458	0.00234253	24.76681942	3397.80157	60000.00000
4.188306E+08	4.351486E+12	0.00009625	0.00237325	24.65711850	3399.34294	60000.00000
4.192528E+08	4.281731E+12	0.00009792	0.00240404	24.55194157	3399.98156	60000.00000
4.196653E+08	4.214212E+12	0.00009958	0.00243503	24.45221704	3395.38769	60000.00000
4.200742E+08	4.148881E+12	0.00010125	0.00246611	24.35663098	3389.59867	60000.00000
4.204675E+08	4.085515E+12	0.00010292	0.00249746	24.26678056	3383.73787	60000.00000
4.204675E+08	4.020407E+12	0.00010458	0.00253092	24.19999856	3379.76754	60000.00000
4.204675E+08	3.957342E+12	0.00010625	0.00257125	24.19999856	3386.74680	60000.00000
4.208985E+08	3.900217E+12	0.00010792	0.00261158	24.19999856	3392.25526	60000.00000
4.220991E+08	3.851855E+12	0.00010958	0.00264902	24.17356664	3395.93695	60000.00000
4.223088E+08	3.796034E+12	0.00011125	0.00267986	24.08860606	3397.88513	60000.00000
4.225165E+08	3.741844E+12	0.00011292	0.00271076	24.00675720	3399.20670	60000.00000
4.227224E+08	3.689214E+12	0.00011458	0.00274174	23.92789811	3399.89447	60000.00000
4.229109E+08	3.637944E+12	0.00011625	0.00277318	23.85535294	3397.83583	60000.00000
4.232583E+08	3.539442E+12	0.00011958	0.00283693	23.72342151	3387.77541	60000.00000
4.236011E+08	3.446246E+12	0.00012292	0.00290087	23.60030991	3377.66094	60000.00000
4.239317E+08	3.357875E+12	0.00012625	0.00296524	23.48701340	3376.78559	60000.00000
4.241783E+08	3.273401E+12	0.00012958	0.00302982	23.38123852	3385.30625	60000.00000
4.243690E+08	3.192745E+12	0.00013292	0.00309369	23.27543217	3391.76040	60000.00000
4.245551E+08	3.116001E+12	0.00013625	0.00315779	23.17645901	3396.38750	60000.00000
4.247363E+08	3.042887E+12	0.00013958	0.00322212	23.08387452	3399.14698	60000.00000
4.248910E+08	2.972998E+12	0.00014292	0.00328743	23.00242692	3399.29031	60000.00000
4.250180E+08	2.906106E+12	0.00014625	0.00335380	22.93198639	3390.47219	60000.00000
4.251422E+08	2.842176E+12	0.00014958	0.00342034	22.86578268	3381.61069	60000.00000
4.252636E+08	2.781015E+12	0.00015292	0.00348705	22.80356795	3372.70463	60000.00000
4.253552E+08	2.722273E+12	0.00015625	0.00355321	22.74055463	3363.94114	60000.00000
4.254075E+08	2.665739E+12	0.00015958	0.00361857	22.67509049	3367.69721	60000.00000
4.254557E+08	2.611493E+12	0.00016292	0.00368415	22.61370975	3376.02769	60000.00000
4.254777E+08	2.559265E+12	0.00016625	0.00375091	22.56188840	3383.41921	60000.00000
4.254968E+08	2.509072E+12	0.00016958	0.00381787	22.51322991	3389.49075	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 424064.41017 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number            =          1
Depth below pile head        =     60.000 in
Depth below ground surface   =     48.000 in
Equivalent Depth (see note)  =     48.000 in
Pile Diameter                =    132.000 in
Angle of Friction            =     46.000 deg.
Avg. Eff. Unit Weight        =    0.05300 pci
k                            =    225.000 pci
A (static)                   =     2.5755
B (static)                   =     1.9145
Pst                          =   2979.144 lbs/in
Psd                          =  82368.160 lbs/in
Ps                           =   2979.144 lbs/in
Cbar                         =  4587.6751
n                            =     3.6210
```

```
m                              =     715.9795
yk                             =       0.3064 in
pm                             =     5703.707 lbs/in
ym                             =       2.2000 in
pu                             =     7672.651 lbs/in
yu                             =       4.9500 in
p-multiplier                   =      1.00000
y-multiplier                   =      1.00000
```

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in	
0.0000	0.0000	
0.1833333	1980.0000	*
0.3666667	3477.4460	
0.5500000	3889.4693	
0.7333333	4211.0834	
0.9166667	4478.7502	
1.1000	4710.0313	
1.2833	4914.8701	
1.4667	5099.4965	
1.6500	5268.0968	
1.8333	5423.6329	
2.0167	5568.2847	
2.2000	5703.7075	
3.5750	6688.1793	
4.9500	7672.6512	
136.9500	7672.6512	
268.9500	7672.6512	

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

```
Soil Layer Number            =          3
Depth below pile head        =      174.000 in
Depth below ground surface   =      162.000 in
Equivalent Depth             =      231.381 in
Diameter                     =      132.000 in
Undrained cohesion, c        =      3.48000 lbs/in**2
Average Eff. Unit Weight     =      0.06404 lbs/in**3
Epsilon-50                   =      0.01100
Pct                          =     3736.521 lbs/in
Pcd                          =     4134.240 lbs/in
Pu                           =     3736.521 lbs/in
y50                          =        3.630 in
p-multiplier                 =      1.00000
y-multiplier                 =      1.00000
```

y, in	p, lbs/in
0.0000	0.0000
0.0005808	210.1200
0.0029040	314.2027
0.0058080	373.6521
0.0290400	558.7402
0.0580800	664.4578
0.2904000	993.5962
0.5808000	1181.5916
1.4520	1485.7728
2.9040	1766.8916
4.3560	1955.3870
5.8080	2101.2001
14.5200	2642.1193
29.0400	3142.0270
58.0800	3736.5209
65.3400	3736.5209
72.6000	3736.5209

```
p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =         4
Depth below pile head      =     348.000 in
Depth below ground surface =     336.000 in
Equivalent Depth           =     270.291 in
Diameter                   =     132.000 in
Undrained cohesion, c      =     9.20000 lbs/in**2
Average Eff. Unit Weight   =     0.06616 lbs/in**3
Epsilon-50                 =     0.00700
Pct                        =    7247.048 lbs/in
Pcd                        =   10929.600 lbs/in
Pu                         =    7247.048 lbs/in
y50                        =       2.310 in
p-multiplier               =     1.00000
y-multiplier               =     1.00000

        y, in           p, lbs/in
----------------    -----------------
         0.0000          0.0000
      0.0003696        407.5314
      0.0018480        609.4016
      0.0036960        724.7047
      0.0184800       1083.6864
      0.0369600       1288.7276
      0.1848000       1927.0971
      0.3696000       2291.7176
      0.9240000       2881.6824
         1.8480       3426.9172
         2.7720       3792.5073
         3.6960       4075.3143
         9.2400       5124.4364
        18.4800       6094.0163
        36.9600       7247.0475
        41.5800       7247.0475
        46.2000       7247.0475
```

```
p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =         6
Depth below pile head      =     513.000 in
Depth below ground surface =     501.000 in
Equivalent Depth           =     358.732 in
Diameter                   =     132.000 in
Undrained cohesion, c      =    17.00000 lbs/in**2
Average Eff. Unit Weight   =     0.05899 lbs/in**3
Epsilon-50                 =     0.00500
Pct                        =   12574.459 lbs/in
Pcd                        =   20196.000 lbs/in
Pu                         =   12574.459 lbs/in
y50                        =       1.650 in
p-multiplier               =     1.00000
y-multiplier               =     1.00000

        y, in           p, lbs/in
----------------    -----------------
         0.0000          0.0000
      0.0002640        707.1138
      0.0013200       1057.3817
      0.0026400       1257.4459
      0.0132000       1880.3202
      0.0264000       2236.0902
      0.1320000       3343.7347
      0.2640000       3976.3930
      0.6600000       5000.0496
         1.3200       5946.0945
         1.9800       6580.4354
         2.6400       7071.1379
         6.6000       8891.4852
        13.2000      10573.8175
        26.4000      12574.4590
        29.7000      12574.4590
        33.0000      12574.4590
```

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	7
Depth below pile head	=	690.000 in
Depth below ground surface	=	678.000 in
Equivalent Depth	=	540.066 in
Diameter	=	132.000 in
Undrained cohesion, c	=	13.00000 lbs/in**2
Average Eff. Unit Weight	=	0.05275 lbs/in**3
Epsilon-50	=	0.00700
Pct	=	12419.062 lbs/in
Pcd	=	15444.000 lbs/in
Pu	=	12419.062 lbs/in
y50	=	2.310 in
p-multiplier	=	1.00000
y-multiplier	=	1.00000

y, in	p, lbs/in
0.0000	0.0000
0.0003696	698.3752
0.0018480	1044.3145
0.0036960	1241.9062
0.0184800	1857.0830
0.0369600	2208.4563
0.1848000	3302.4124
0.3696000	3927.2523
0.9240000	4938.2584
1.8480	5872.6120
2.7720	6499.1135
3.6960	6983.7519
9.2400	8781.6031
18.4800	10443.1449
36.9600	12419.0622
41.5800	12419.0622
46.2000	12419.0622

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 319693.000 lbs
Specified moment at pile head = 345051000.000 in-lbs
Specified axial load at pile head = 189766.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	5.528	3.45E+08	3.20E+05	-0.019200	1542.001	1.16E+13	0.000	0.000
8.400	5.368	3.48E+08	3.20E+05	-0.018948	1554.029	1.16E+13	0.000	0.000
16.800	5.210	3.50E+08	3.20E+05	-0.018695	1566.055	1.16E+13	0.000	0.000
25.200	5.054	3.53E+08	3.20E+05	-0.018435	1578.079	1.12E+13	0.000	0.000
33.600	4.900	3.56E+08	3.20E+05	-0.018166	1590.101	1.10E+13	0.000	0.000
42.000	4.749	3.59E+08	3.20E+05	-0.017891	1602.121	1.08E+13	0.000	0.000
50.400	4.600	3.61E+08	2.96E+05	-0.017608	1614.140	1.06E+13	-5659.833	10336.
58.800	4.453	3.64E+08	2.42E+05	-0.017318	1624.387	1.04E+13	-7093.340	13381.
67.200	4.309	3.65E+08	1.77E+05	-0.017022	1632.416	1.03E+13	-8569.931	16707.
75.600	4.167	3.67E+08	1.35E+05	-0.016720	1637.765	1.02E+13	-1360.079	2741.703
84.000	4.028	3.68E+08	1.23E+05	-0.016415	1642.687	1.01E+13	-1409.106	2938.686
92.400	3.891	3.69E+08	1.11E+05	-0.016107	1647.166	9.98E+12	-1454.632	3140.125
100.800	3.757	3.70E+08	98810.	-0.015795	1651.188	9.90E+12	-1497.380	3347.682
109.200	3.626	3.71E+08	86062.	-0.015480	1654.741	9.83E+12	-1537.821	3562.651
117.600	3.497	3.71E+08	72983.	-0.015162	1657.810	9.78E+12	-1576.274	3786.122
126.000	3.371	3.72E+08	59588.	-0.014842	1660.385	9.72E+12	-1612.962	4019.072
134.400	3.248	3.72E+08	46056.	-0.014520	1662.453	9.68E+12	-1608.933	4161.259
142.800	3.127	3.73E+08	32420.	-0.014196	1664.016	9.65E+12	-1637.721	4399.074
151.200	3.009	3.73E+08	18547.	-0.013871	1665.066	9.63E+12	-1665.449	4648.794
159.600	2.894	3.73E+08	4444.962	-0.013546	1665.592	9.62E+12	-1692.138	4911.217
168.000	2.782	3.73E+08	-9876.790	-0.013220	1665.588	9.62E+12	-1717.803	5187.186
176.400	2.672	3.73E+08	-24410.	-0.012894	1665.044	9.63E+12	-1742.457	5477.600
184.800	2.565	3.73E+08	-39146.	-0.012569	1663.954	9.65E+12	-1766.107	5783.418
193.200	2.461	3.72E+08	-54076.	-0.012246	1662.309	9.68E+12	-1788.759	6105.670
201.600	2.359	3.72E+08	-69193.	-0.011924	1660.103	9.73E+12	-1810.418	6445.462

210.000	2.261	3.71E+08	-84487.	-0.011604	1657.329	9.79E+12	-1831.084	6803.990
218.400	2.164	3.70E+08	-99807.	-0.011287	1653.981	9.85E+12	-1816.465	7049.464
226.800	2.071	3.69E+08	-1.15E+05	-0.010973	1650.063	9.92E+12	-1796.526	7286.801
235.200	1.980	3.68E+08	-1.30E+05	-0.010662	1645.581	1.00E+13	-1776.489	7536.152
243.600	1.892	3.67E+08	-1.45E+05	-0.010354	1640.542	1.01E+13	-1756.354	7798.325
252.000	1.806	3.66E+08	-1.59E+05	-0.010051	1634.952	1.02E+13	-1736.118	8074.210
260.400	1.723	3.65E+08	-1.74E+05	-0.009752	1628.817	1.03E+13	-1715.778	8364.777
268.800	1.642	3.63E+08	-1.88E+05	-0.009458	1622.144	1.04E+13	-1695.332	8671.094
277.200	1.564	3.62E+08	-2.02E+05	-0.009169	1614.939	1.06E+13	-1674.775	8994.336
285.600	1.488	3.60E+08	-2.22E+05	-0.008884	1607.209	1.07E+13	-2862.930	16158.
294.000	1.415	3.58E+08	-2.46E+05	-0.008604	1598.582	1.09E+13	-2877.825	17086.
302.400	1.344	3.56E+08	-2.70E+05	-0.008330	1539.054	1.10E+13	-2891.224	18074.
310.800	1.275	3.53E+08	-2.94E+05	-0.008062	1578.620	1.12E+13	-2903.098	19128.
319.200	1.208	3.51E+08	-3.19E+05	-0.007800	1567.278	1.14E+13	-2913.413	20254.
327.600	1.144	3.48E+08	-3.43E+05	-0.007543	1555.023	1.15E+13	-2922.129	21459.
336.000	1.082	3.45E+08	-3.68E+05	-0.007293	1541.853	1.17E+13	-2929.205	22750.
344.400	1.021	3.42E+08	-3.92E+05	-0.007049	1527.766	1.19E+13	-2934.591	24135.
352.800	0.963139	3.38E+08	-4.17E+05	-0.006812	1512.761	1.22E+13	-2938.235	25626.
361.200	0.906899	3.35E+08	-4.42E+05	-0.006581	1496.835	1.23E+13	-2940.069	27232.
369.600	0.852579	3.31E+08	-4.66E+05	-0.006355	1479.990	1.25E+13	-2940.034	28967.
378.000	0.800134	3.27E+08	-4.91E+05	-0.006135	1462.224	1.26E+13	-2938.058	30844.
386.400	0.749513	3.23E+08	-5.16E+05	-0.005920	1443.538	1.28E+13	-2934.057	32883.
394.800	0.700670	3.18E+08	-5.40E+05	-0.005712	1423.934	1.30E+13	-2927.937	35102.
403.200	0.653559	3.14E+08	-5.65E+05	-0.005508	1403.413	1.31E+13	-2893.615	37191.
411.600	0.608135	3.09E+08	-5.89E+05	-0.005310	1381.987	1.32E+13	-2871.175	39659.
420.000	0.564358	3.04E+08	-6.13E+05	-0.005116	1359.663	1.33E+13	-2846.621	42370.
428.400	0.522188	2.99E+08	-6.37E+05	-0.004927	1336.447	1.34E+13	-2819.826	45360.
436.800	0.481590	2.93E+08	-6.60E+05	-0.004742	1312.349	1.34E+13	-2790.646	48675.
445.200	0.442530	2.88E+08	-6.84E+05	-0.004560	1287.377	1.35E+13	-2758.915	52369.
453.600	0.404979	2.82E+08	-7.07E+05	-0.004383	1261.543	1.35E+13	-2724.436	56510.
462.000	0.368904	2.76E+08	-7.31E+05	-0.004209	1234.855	1.35E+13	-3069.085	69884.
470.400	0.334273	2.69E+08	-7.61E+05	-0.004039	1207.207	1.35E+13	-4016.571	1.01E+05
478.800	0.301053	2.63E+08	-7.94E+05	-0.003873	1178.303	1.35E+13	-3951.741	1.10E+05
487.200	0.269207	2.56E+08	-8.27E+05	-0.003711	1148.163	1.35E+13	-3880.558	1.21E+05
495.600	0.238701	2.49E+08	-8.59E+05	-0.003554	1116.809	1.35E+13	-3802.150	1.34E+05
504.000	0.209495	2.42E+08	-8.91E+05	-0.003402	1084.266	1.35E+13	-3715.375	1.49E+05
512.400	0.181551	2.34E+08	-9.22E+05	-0.003254	1050.561	1.35E+13	-3618.712	1.67E+05
520.800	0.154827	2.26E+08	-9.52E+05	-0.003111	1015.724	1.35E+13	-3510.065	1.90E+05
529.200	0.129283	2.18E+08	-9.81E+05	-0.002973	979.789	1.36E+13	-3386.428	2.20E+05
537.600	0.104874	2.10E+08	-1.01E+06	-0.002841	942.795	1.36E+13	-3243.273	2.60E+05
546.000	0.081556	2.01E+08	-1.04E+06	-0.002714	904.787	1.36E+13	-3073.259	3.17E+05
554.400	0.059284	1.92E+08	-1.06E+06	-0.002592	865.817	1.36E+13	-2863.182	4.06E+05
562.800	0.038011	1.83E+08	-1.08E+06	-0.002476	825.952	1.36E+13	-2584.865	5.71E+05
571.200	0.017690	1.74E+08	-1.10E+06	-0.002365	785.278	1.36E+13	-2153.908	1.02E+06
579.600	-0.001728	1.65E+08	-1.11E+06	-0.002261	743.931	1.36E+13	883.923	4.30E+06
588.000	-0.020293	1.56E+08	-1.09E+06	-0.002162	702.859	1.36E+13	2266.967	9.38E+05
596.400	-0.038052	1.46E+08	-1.07E+06	-0.002069	662.494	1.36E+13	2675.572	5.91E+05
604.800	-0.055054	1.38E+08	-1.05E+06	-0.001982	622.965	1.37E+13	2959.197	4.52E+05
613.200	-0.071345	1.29E+08	-1.02E+06	-0.001900	584.360	1.37E+13	3183.698	3.75E+05
621.600	-0.086971	1.20E+08	-9.97E+05	-0.001852	546.750	6.01E+13	3372.966	3.26E+05
630.000	-0.102456	1.12E+08	-9.68E+05	-0.001836	510.193	6.02E+13	3542.788	2.90E+05
638.400	-0.117809	1.04E+08	-9.38E+05	-0.001821	474.744	6.03E+13	3698.411	2.64E+05
646.800	-0.133041	9.63E+07	-9.06E+05	-0.001807	440.450	6.04E+13	3843.204	2.43E+05
655.200	-0.148160	8.88E+07	-8.73E+05	-0.001794	407.357	6.04E+13	3979.469	2.26E+05
663.600	-0.163175	8.17E+07	-8.39E+05	-0.001782	375.507	6.05E+13	4108.851	2.12E+05
672.000	-0.178095	7.48E+07	-8.06E+05	-0.001771	344.941	6.06E+13	3875.261	1.83E+05
680.400	-0.192929	6.81E+07	-7.76E+05	-0.001761	315.586	6.07E+13	3307.852	1.44E+05
688.800	-0.207682	6.17E+07	-7.47E+05	-0.001752	287.265	6.07E+13	3396.288	1.37E+05
697.200	-0.222364	5.56E+07	-7.18E+05	-0.001744	260.005	6.08E+13	3482.154	1.32E+05
705.600	-0.236982	4.97E+07	-6.89E+05	-0.001737	233.833	6.09E+13	3565.804	1.26E+05
714.000	-0.251542	4.40E+07	-6.59E+05	-0.001730	208.775	6.09E+13	3647.530	1.22E+05
722.400	-0.266051	3.86E+07	-6.28E+05	-0.001725	184.858	6.10E+13	3727.574	1.18E+05
730.800	-0.280516	3.35E+07	-5.92E+05	-0.001720	162.104	6.10E+13	4809.938	1.44E+05
739.200	-0.294941	2.87E+07	-5.51E+05	-0.001715	140.854	6.11E+13	4907.956	1.40E+05
747.600	-0.309334	2.42E+07	-5.09E+05	-0.001712	121.138	6.11E+13	5004.514	1.36E+05
756.000	-0.323698	2.01E+07	-4.67E+05	-0.001709	102.985	6.11E+13	5099.775	1.32E+05
764.400	-0.338040	1.64E+07	-4.24E+05	-0.001706	86.426	6.11E+13	5193.874	1.29E+05
772.800	-0.352362	1.30E+07	-3.80E+05	-0.001704	71.490	6.11E+13	5286.934	1.26E+05
781.200	-0.366670	1.00E+07	-3.35E+05	-0.001703	58.207	6.11E+13	5379.059	1.23E+05
789.600	-0.380965	7.39E+06	-2.89E+05	-0.001701	46.604	6.11E+13	5470.341	1.21E+05
798.000	-0.395253	5.16E+06	-2.43E+05	-0.001701	36.710	6.11E+13	5560.861	1.18E+05
806.400	-0.409534	3.32E+06	-1.96E+05	-0.001700	28.554	6.11E+13	5650.689	1.16E+05
814.800	-0.423812	1.87E+06	-1.48E+05	-0.001700	22.164	6.11E+13	5739.889	1.14E+05
823.200	-0.438087	8.36E+05	-99397.	-0.001699	17.568	6.11E+13	5828.514	1.12E+05
831.600	-0.452362	2.09E+05	-50068.	-0.001699	14.793	6.11E+13	5916.615	1.10E+05
840.000	-0.466636	0.000	0.000	-0.001699	13.867	6.11E+13	6004.233	54042.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

```
Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection              =     5.52826478 in
Computed slope at pile head       =    -0.01920018
Maximum bending moment            =   3.729577E+08 lbs-in
Maximum shear force               =      -1108184. lbs
Depth of maximum bending moment   =      159.60000 in
Depth of maximum shear force      =      579.60000 in
Number of iterations              =             58
Number of zero deflection points  =              1




------------------------------------------------------------------------------
                          Summary of Pile Response(s)
------------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2            lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  3.20E+05 M=  3.45E+08     189766.      5.5283  3.7296E+08   -1108184.

The analysis ended normally.
```

B.9 Undrained Analysis from 6.0-in. Triaxial Test (Service)

```
===============================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.47)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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                            All Rights Reserved

===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                            Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using 6 in Undrained Strengths.lpd
Name of output file:         Drilled Shaft Analysis Using 6 in Undrained Strengths.lpo
Name of plot output file:    Drilled Shaft Analysis Using 6 in Undrained Strengths.lpp
Name of runtime file:        Drilled Shaft Analysis Using 6 in Undrained Strengths.lpr


------------------------------------------------------------------------------
                          Time and Date of Analysis
------------------------------------------------------------------------------

              Date:  October 11, 2012     Time:  13:06:12


------------------------------------------------------------------------------
                                Problem Title
------------------------------------------------------------------------------

Drilled Shaft Analysis:  Undrained Strengths Obtained from 6 in. Triaxial Test


------------------------------------------------------------------------------
                               Program Options
------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments            =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
```

```
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                  Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                =    1140.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface              =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
           in           in         in**4         Sq.in      lbs/Sq.in
-----  ---------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000    14902723.   13685.0000      3604997.
  2    1140.0000     132.00000    14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.


--------------------------------------------------------------------------------
                     Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  8 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       12.000 in
Distance from top of pile to bottom of layer =       72.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is stiff clay without free water
Distance from top of pile to top of layer    =       72.000 in
Distance from top of pile to bottom of layer =      132.000 in

Layer  3 is stiff clay without free water
Distance from top of pile to top of layer    =      132.000 in
Distance from top of pile to bottom of layer =      282.000 in

Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in

Layer  5 is stiff clay without free water
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      462.000 in

Layer  6 is stiff clay without free water
Distance from top of pile to top of layer    =      462.000 in
Distance from top of pile to bottom of layer =      672.000 in

Layer  7 is stiff clay without free water
Distance from top of pile to top of layer    =      672.000 in
Distance from top of pile to bottom of layer =      732.000 in

Layer  8 is stiff clay without free water
Distance from top of pile to top of layer    =      732.000 in
Distance from top of pile to bottom of layer =     1200.000 in


(Depth of lowest layer extends   60.00 in below pile tip)


--------------------------------------------------------------------------------
                  Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 16 points
```

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.03300
10	462.00	0.03300
11	462.00	0.03500
12	672.00	0.03500
13	672.00	0.03600
14	732.00	0.03600
15	732.00	0.03500
16	1200.00	0.03500

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	3.48000	0.00	------	------
4	132.000	3.48000	0.00	------	------
5	132.000	3.48000	0.00	------	------
6	282.000	3.48000	0.00	------	------
7	282.000	3.48000	0.00	------	------
8	396.000	3.48000	0.00	------	------
9	396.000	3.48000	0.00	------	------
10	462.000	3.48000	0.00	------	------
11	462.000	7.00000	0.00	------	------
12	672.000	7.00000	0.00	------	------
13	672.000	3.48000	0.00	------	------
14	732.000	3.48000	0.00	------	------
15	732.000	7.00000	0.00	------	------
16	1200.000	7.00000	0.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.001	1.0000	1.0000
4	1200.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 221503.000 lbs
Bending moment at pile head = 235128000.000 in-lbs
Axial load at pile head = 117367.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Output of p-y Curves at Specified Depths

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p-y curves are generated and printed for verification at 5 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	48.000
2	174.000	162.000
3	348.000	336.000
4	513.000	501.000
5	690.000	678.000

Depth of ground surface below top of pile = 12.00 in

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Number of sections = 1

Pile Section No. 1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter = 132.0000 in

Material Properties:

Compressive Strength of Concrete = 4.000 kip/in**2
Yield Stress of Reinforcement = 60. kip/in**2
Modulus of Elasticity of Reinforcement = 29000. kip/in**2
Number of Reinforcing Bars = 90
Area of Single Bar = 1.56000 in**2
Number of Rows of Reinforcing Bars = 45
Area of Steel = 140.400 in**2
Area of Shaft = 13684.778 in**2
Percentage of Steel Reinforcement = 1.026 percent
Cover Thickness (edge to bar center) = 4.000 in

Unfactored Axial Squash Load Capacity = 54474.89 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	3.120	61.962
2	3.120	61.660
3	3.120	61.058
4	3.120	60.158
5	3.120	58.966
6	3.120	57.485

7	3.120	55.725
8	3.120	53.694
9	3.120	51.400
10	3.120	48.857
11	3.120	46.075
12	3.120	43.069
13	3.120	39.853
14	3.120	36.443
15	3.120	32.855
16	3.120	29.107
17	3.120	25.218
18	3.120	21.205
19	3.120	17.090
20	3.120	12.891
21	3.120	8.629
22	3.120	4.325
23	3.120	0.000
24	3.120	-4.325
25	3.120	-8.629
26	3.120	-12.891
27	3.120	-17.090
28	3.120	-21.205
29	3.120	-25.218
30	3.120	-29.107
31	3.120	-32.855
32	3.120	-36.443
33	3.120	-39.853
34	3.120	-43.069
35	3.120	-46.075
36	3.120	-48.857
37	3.120	-51.400
38	3.120	-53.694
39	3.120	-55.725
40	3.120	-57.485
41	3.120	-58.966
42	3.120	-60.158
43	3.120	-61.058
44	3.120	-61.660
45	3.120	-61.962

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25787557.	6.189014E+13	4.166667E-07	0.00002759	66.21427399	97.94913580	751.29944
51348729.	6.161847E+13	8.333333E-07	0.00005518	66.21381372	194.46533	1502.58775
76683516.	6.134681E+13	0.00000125	0.00008277	66.21334952	289.54864	2253.86480
1.017919E+08	6.107515E+13	0.00000167	0.00011035	66.21287745	383.19907	3005.13026
1.266739E+08	6.080349E+13	0.00000208	0.00013794	66.21240145	475.41669	3756.38406
1.266739E+08	5.066957E+13	0.00000250	0.00008432	33.72696823	290.15987	6832.05657
1.266739E+08	4.343106E+13	0.00000292	0.00009843	33.74794382	337.47299	7968.95848
1.266739E+08	3.800218E+13	0.00000333	0.00011256	33.76901776	384.48442	9105.34397
1.266739E+08	3.377972E+13	0.00000375	0.00012671	33.79018611	431.19311	10241.20991
1.266739E+08	3.040174E+13	0.00000417	0.00014088	33.81144494	477.59798	11376.55335
1.266739E+08	2.763795E+13	0.00000458	0.00015507	33.83280605	523.69813	12511.36944
1.266739E+08	2.533479E+13	0.00000500	0.00016927	33.85425764	569.49235	13645.65618
1.266739E+08	2.338596E+13	0.00000542	0.00018349	33.87581152	614.97974	14779.40844
1.266739E+08	2.171553E+13	0.00000583	0.00019774	33.89746374	660.15918	15912.62317
1.266739E+08	2.026783E+13	0.00000625	0.00021200	33.91921431	705.02956	17045.29683
1.266739E+08	1.900109E+13	0.00000667	0.00022627	33.94106716	749.58988	18177.42506
1.266739E+08	1.788338E+13	0.00000708	0.00024057	33.96302229	793.83901	19309.00418
1.266739E+08	1.688986E+13	0.00000750	0.00025489	33.98507971	837.77583	20440.03047
1.266739E+08	1.600092E+13	0.00000792	0.00026922	34.00723940	881.39920	21570.50022
1.266739E+08	1.520087E+13	0.00000833	0.00028358	34.02950531	924.70806	22700.40877
1.298377E+08	1.483860E+13	0.00000875	0.00029795	34.05187351	967.70116	23829.75328
1.359483E+08	1.483072E+13	0.00000917	0.00031235	34.07435185	1010.37751	24958.52795
1.420519E+08	1.482281E+13	0.00000958	0.00032676	34.09693247	1052.73571	26086.73096
1.481487E+08	1.481487E+13	0.00001000	0.00034120	34.11962718	1094.77489	27214.35519
1.542385E+08	1.480690E+13	0.00001042	0.00035565	34.14242810	1136.49361	28341.39888
1.603213E+08	1.479889E+13	0.00001083	0.00037012	34.16534311	1177.89086	29467.85570
1.663972E+08	1.479086E+13	0.00001125	0.00038462	34.18836826	1218.96529	30593.72281
1.724659E+08	1.478279E+13	0.00001167	0.00039913	34.21150357	1259.71561	31718.99621
1.785276E+08	1.477470E+13	0.00001208	0.00041367	34.23475689	1300.14083	32843.66915
1.845821E+08	1.476657E+13	0.00001250	0.00042823	34.25812429	1340.23951	33967.73878
1.906294E+08	1.475840E+13	0.00001292	0.00044280	34.28160578	1380.01034	35091.20097
1.966694E+08	1.475021E+13	0.00001333	0.00045740	34.30520922	1419.45230	36214.04853
2.027022E+08	1.474198E+13	0.00001375	0.00047202	34.32892674	1458.56374	37336.28018
2.087276E+08	1.473371E+13	0.00001417	0.00048666	34.35276622	1497.34361	38457.88856

2.147457E+08	1.472542E+13	0.00001458	0.00050133	34.37672764	1535.79053	39578.86925
2.207563E+08	1.471709E+13	0.00001500	0.00051601	34.40081102	1573.90313	40699.21781
2.267594E+08	1.470872E+13	0.00001542	0.00053072	34.42501634	1611.67998	41818.92984
2.327551E+08	1.470032E+13	0.00001583	0.00054545	34.44934756	1649.11984	42937.99911
2.387431E+08	1.469189E+13	0.00001625	0.00056020	34.47380859	1686.22142	44056.41919
2.506963E+08	1.467491E+13	0.00001708	0.00058977	34.52310437	1759.40324	46291.30079
2.626186E+08	1.465778E+13	0.00001792	0.00061943	34.57292730	1831.21458	48523.52586
2.745096E+08	1.464051E+13	0.00001875	0.00064919	34.62328130	1901.64341	50753.05405
2.863689E+08	1.462309E+13	0.00001958	0.00067904	34.67417818	1970.67778	52979.84015
2.981959E+08	1.460551E+13	0.00002042	0.00070898	34.72562975	2038.30540	55203.83782
3.099903E+08	1.458778E+13	0.00002125	0.00073903	34.77764779	2104.51365	57424.99957
3.217517E+08	1.456989E+13	0.00002208	0.00076917	34.83025199	2169.28998	59643.27173
3.318757E+08	1.448185E+13	0.00002292	0.00079794	34.81911510	2229.47708	60000.00000
3.400568E+08	1.431818E+13	0.00002375	0.00082499	34.73645979	2284.58155	60000.00000
3.471128E+08	1.411984E+13	0.00002458	0.00085103	34.61807674	2336.29173	60000.00000
3.534069E+08	1.390453E+13	0.00002542	0.00087637	34.47995728	2385.38663	60000.00000
3.590686E+08	1.367881E+13	0.00002625	0.00090111	34.32786459	2432.16364	60000.00000
3.642042E+08	1.344754E+13	0.00002708	0.00092534	34.16629118	2476.87014	60000.00000
3.689177E+08	1.321496E+13	0.00002792	0.00094915	33.99947780	2519.75073	60000.00000
3.733099E+08	1.298469E+13	0.00002875	0.00097265	33.83145672	2561.04671	60000.00000
3.772405E+08	1.275179E+13	0.00002958	0.00099565	33.65590221	2600.46397	60000.00000
3.809654E+08	1.252489E+13	0.00003042	0.00101845	33.48322338	2638.57987	60000.00000
3.844461E+08	1.230227E+13	0.00003125	0.00104098	33.31151623	2675.33276	60000.00000
3.876586E+08	1.208287E+13	0.00003208	0.00106321	33.13913244	2710.67250	60000.00000
3.911079E+08	1.188176E+13	0.00003292	0.00108625	33.00000197	2746.41666	60000.00000
3.937652E+08	1.166712E+13	0.00003375	0.00111014	32.89313346	2782.53804	60000.00000
3.964202E+08	1.146275E+13	0.00003458	0.00113131	32.71251208	2813.51852	60000.00000
3.990118E+08	1.126622E+13	0.00003542	0.00115242	32.53885370	2843.62159	60000.00000
4.013191E+08	1.107087E+13	0.00003625	0.00117310	32.36138731	2872.31936	60000.00000
4.036190E+08	1.088411E+13	0.00003708	0.00119382	32.19288236	2900.30825	60000.00000
4.057795E+08	1.070188E+13	0.00003792	0.00121434	32.02646238	2927.26089	60000.00000
4.077671E+08	1.052302E+13	0.00003875	0.00123459	31.86037284	2953.11762	60000.00000
4.097479E+08	1.035153E+13	0.00003958	0.00125488	31.70215899	2978.29193	60000.00000
4.116459E+08	1.018505E+13	0.00004042	0.00127505	31.54766661	3002.59564	60000.00000
4.133489E+08	1.002058E+13	0.00004125	0.00129489	31.39131349	3025.77493	60000.00000
4.150456E+08	9.862470E+12	0.00004208	0.00131477	31.24194700	3048.29687	60000.00000
4.167360E+08	9.710353E+12	0.00004292	0.00133467	31.09916192	3070.15785	60000.00000
4.182788E+08	9.560659E+12	0.00004375	0.00135431	30.95572382	3091.02531	60000.00000
4.197250E+08	9.414393E+12	0.00004458	0.00137379	30.81404811	3111.04082	60000.00000
4.214537E+08	9.279714E+12	0.00004542	0.00139848	30.79215986	3135.68928	60000.00000
4.228530E+08	9.142767E+12	0.00004625	0.00141744	30.64725047	3153.66581	60000.00000
4.242068E+08	9.009703E+12	0.00004708	0.00143632	30.50595242	3170.94185	60000.00000
4.253891E+08	8.877686E+12	0.00004792	0.00145481	30.36126727	3187.22812	60000.00000
4.265665E+08	8.750082E+12	0.00004875	0.00147333	30.22214073	3202.93999	60000.00000
4.277391E+08	8.626670E+12	0.00004958	0.00149188	30.08830529	3218.07492	60000.00000
4.300423E+08	8.391070E+12	0.00005125	0.00152899	29.83397037	3246.54184	60000.00000
4.319998E+08	8.163775E+12	0.00005292	0.00156529	29.58030421	3272.01560	60000.00000
4.339391E+08	7.950030E+12	0.00005458	0.00160171	29.34428161	3295.25396	60000.00000
4.358387E+08	7.748243E+12	0.00005625	0.00163818	29.12314492	3316.19503	60000.00000
4.374438E+08	7.552987E+12	0.00005792	0.00167388	28.90152043	3334.41710	60000.00000
4.390320E+08	7.368369E+12	0.00005958	0.00170970	28.69422716	3350.45871	60000.00000
4.402956E+08	7.188499E+12	0.00006125	0.00175175	28.59999830	3366.54094	60000.00000
4.423675E+08	7.031007E+12	0.00006292	0.00178857	28.42768139	3377.97382	60000.00000
4.435896E+08	6.868484E+12	0.00006458	0.00182239	28.21769339	3386.34100	60000.00000
4.447974E+08	6.713923E+12	0.00006625	0.00185632	28.01991230	3392.73687	60000.00000
4.459908E+08	6.566735E+12	0.00006792	0.00189036	27.83346480	3397.14127	60000.00000
4.471696E+08	6.426389E+12	0.00006958	0.00192451	27.65756017	3399.53350	60000.00000
4.481224E+08	6.289437E+12	0.00007125	0.00195781	27.47809535	3397.47132	60000.00000
4.490422E+08	6.158293E+12	0.00007292	0.00199121	27.30801684	3389.13169	60000.00000
4.499549E+08	6.032915E+12	0.00007458	0.00202471	27.14700598	3391.89791	60000.00000
4.508604E+08	5.912923E+12	0.00007625	0.00205833	26.99448448	3396.12040	60000.00000
4.517586E+08	5.797971E+12	0.00007792	0.00209206	26.84993309	3398.81321	60000.00000
4.525539E+08	5.686541E+12	0.00007958	0.00212537	26.70626682	3399.95080	60000.00000
4.532662E+08	5.578661E+12	0.00008125	0.00215851	26.56622761	3394.58019	60000.00000
4.539711E+08	5.475028E+12	0.00008292	0.00219176	26.43325371	3387.24744	60000.00000
4.566183E+08	5.398443E+12	0.00008458	0.00223300	26.40000039	3389.86771	60000.00000
4.566183E+08	5.294125E+12	0.00008625	0.00227218	26.34416646	3394.95074	60000.00000
4.566183E+08	5.193763E+12	0.00008792	0.00230424	26.20940655	3397.64940	60000.00000
4.570244E+08	5.101667E+12	0.00008958	0.00233639	26.08061832	3399.33318	60000.00000
4.575943E+08	5.014732E+12	0.00009125	0.00236810	25.95172781	3399.98715	60000.00000
4.580891E+08	4.930106E+12	0.00009292	0.00239952	25.82438725	3395.08399	60000.00000
4.585803E+08	4.848426E+12	0.00009458	0.00243102	25.70242435	3389.18152	60000.00000
4.590626E+08	4.769482E+12	0.00009625	0.00246269	25.58640558	3383.23530	60000.00000
4.595137E+08	4.692906E+12	0.00009792	0.00249487	25.47953707	3383.82909	60000.00000
4.599284E+08	4.618528E+12	0.00009958	0.00252765	25.38221616	3388.44361	60000.00000
4.603406E+08	4.546574E+12	0.00010125	0.00256049	25.28880554	3392.29716	60000.00000
4.607281E+08	4.476710E+12	0.00010292	0.00259377	25.20262545	3395.42967	60000.00000
4.611002E+08	4.408926E+12	0.00010458	0.00262733	25.12186629	3397.77531	60000.00000
4.614027E+08	4.342614E+12	0.00010625	0.00266027	25.03787738	3399.25293	60000.00000
4.616766E+08	4.278084E+12	0.00010792	0.00269303	24.95468313	3399.94092	60000.00000
4.619204E+08	4.215243E+12	0.00010958	0.00272638	24.87949044	3396.63991	60000.00000

4.621507E+08	4.154163E+12	0.00011125	0.00276002	24.80915219	3391.14197	60000.00000
4.623791E+08	4.094870E+12	0.00011292	0.00279371	24.74138671	3385.62922	60000.00000
4.626060E+08	4.037289E+12	0.00011458	0.00282747	24.67609960	3380.10111	60000.00000
4.628311E+08	3.981343E+12	0.00011625	0.00286128	24.61317676	3375.27318	60000.00000
4.632524E+08	3.873887E+12	0.00011958	0.00292957	24.49814540	3385.00615	60000.00000
4.636336E+08	3.771934E+12	0.00012292	0.00299877	24.39679617	3392.47464	60000.00000
4.639854E+08	3.675132E+12	0.00012625	0.00306794	24.30050594	3397.39037	60000.00000
4.639854E+08	3.580595E+12	0.00012958	0.00313592	24.19999856	3399.72475	60000.00000
4.639854E+08	3.490799E+12	0.00013292	0.00321658	24.19999856	3391.85144	60000.00000
4.639854E+08	3.405398E+12	0.00013625	0.00329725	24.19999856	3379.25644	60000.00000
4.643191E+08	3.326465E+12	0.00013958	0.00337792	24.19999856	3368.17395	60000.00000
4.651442E+08	3.254653E+12	0.00014292	0.00345309	24.16152889	3379.25053	60000.00000
4.652853E+08	3.181438E+12	0.00014625	0.00352194	24.08165485	3386.56275	60000.00000
4.654226E+08	3.111460E+12	0.00014958	0.00359103	24.00687522	3392.33234	60000.00000
4.655350E+08	3.044370E+12	0.00015292	0.00366122	23.94255584	3396.62145	60000.00000
4.656271E+08	2.980014E+12	0.00015625	0.00373232	23.88687927	3399.22850	60000.00000
4.656924E+08	2.918177E+12	0.00015958	0.00380311	23.83151740	3399.39615	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 463639.80189 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number          =           1
Depth below pile head      =      60.000 in
Depth below ground surface =      48.000 in
Equivalent Depth (see note) =     48.000 in
Pile Diameter              =     132.000 in
Angle of Friction          =      46.000 deg.
Avg. Eff. Unit Weight      =     0.05300 pci
k                          =     225.000 pci
A (static)                 =      2.5755
B (static)                 =      1.9145
Pst                        =    2979.144 lbs/in
Psd                        =   82368.160 lbs/in
Ps                         =    2979.144 lbs/in
Cbar                       =   4587.6751
n                          =      3.6210
m                          =    715.9795
yk                         =      0.3064 in
pm                         =    5703.707 lbs/in
ym                         =      2.2000 in
pu                         =    7672.651 lbs/in
yu                         =      4.9500 in
p-multiplier               =     1.00000
y-multiplier               =     1.00000
```

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in	
0.0000	0.0000	
0.1833333	1980.0000	*
0.3666667	3477.4460	
0.5500000	3889.4693	
0.7333333	4211.0834	
0.9166667	4478.7502	
1.1000	4710.0313	
1.2833	4914.8701	
1.4667	5099.4965	
1.6500	5268.0968	
1.8333	5423.6329	
2.0167	5568.2847	
2.2000	5703.7075	
3.5750	6688.1793	
4.9500	7672.6512	
136.9500	7672.6512	
268.9500	7672.6512	

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

```
Soil Layer Number          =          3
Depth below pile head      =      174.000 in
Depth below ground surface =      162.000 in
Equivalent Depth           =      226.127 in
Diameter                   =      132.000 in
Undrained cohesion, c      =      3.48000 lbs/in**2
Average Eff. Unit Weight   =      0.06404 lbs/in**3
Epsilon-50                 =      0.01100
Pct                        =     3682.971 lbs/in
Pcd                        =     4134.240 lbs/in
Pu                         =     3682.971 lbs/in
y50                        =        3.630 in
p-multiplier               =      1.00000
y-multiplier               =      1.00000

        y, in           p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.0005808         207.1087
      0.0029040         309.6997
      0.0058080         368.2971
      0.0290400         550.7326
      0.0580800         654.9351
      0.2904000         979.3564
      0.5808000        1164.6576
         1.4520        1464.4794
         2.9040        1741.5693
         4.3560        1927.3633
         5.8080        2071.0866
        14.5200        2604.2536
        29.0400        3096.9969
        58.0800        3682.9707
        65.3400        3682.9707
        72.6000        3682.9707



p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =          4
Depth below pile head      =      348.000 in
Depth below ground surface =      336.000 in
Equivalent Depth           =      394.435 in
Diameter                   =      132.000 in
Undrained cohesion, c      =      3.48000 lbs/in**2
Average Eff. Unit Weight   =      0.06616 lbs/in**3
Epsilon-50                 =      0.01100
Pct                        =     5509.082 lbs/in
Pcd                        =     4134.240 lbs/in
Pu                         =     4134.240 lbs/in
y50                        =        3.630 in
p-multiplier               =      1.00000
y-multiplier               =      1.00000

        y, in           p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.0005808         232.4854
      0.0029040         347.6468
      0.0058080         413.4240
      0.0290400         618.2131
      0.0580800         735.1834
      0.2904000        1099.3556
      0.5808000        1307.3615
         1.4520        1643.9200
         2.9040        1954.9614
         4.3560        2163.5205
         5.8080        2324.8540
        14.5200        2923.3491
        29.0400        3476.4676
        58.0800        4134.2400
        65.3400        4134.2400
        72.6000        4134.2400
```

```
p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =          6
Depth below pile head      =      513.000 in
Depth below ground surface =      501.000 in
Equivalent Depth           =      405.304 in
Diameter                   =      132.000 in
Undrained cohesion, c      =      7.00000 lbs/in**2
Average Eff. Unit Weight   =      0.05899 lbs/in**3
Epsilon-50                 =      0.00700
Pct                        =     7346.433 lbs/in
Pcd                        =     8316.000 lbs/in
Pu                         =     7346.433 lbs/in
y50                        =        2.310 in
p-multiplier               =      1.00000
y-multiplier               =      1.00000

        y, in           p, lbs/in
----------------    -----------------
         0.0000            0.0000
      0.0003696          413.1203
      0.0018480          617.7589
      0.0036960          734.6433
      0.0184800         1098.5480
      0.0369600         1306.4011
      0.1848000         1953.5253
      0.3696000         2323.1462
      0.9240000         2921.2017
         1.8480         3473.9138
         2.7720         3844.5177
         3.6960         4131.2031
         9.2400         5194.7128
        18.4800         6177.5894
        36.9600         7346.4333
        41.5800         7346.4333
        46.2000         7346.4333
```

```
p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =          7
Depth below pile head      =      690.000 in
Depth below ground surface =      678.000 in
Equivalent Depth           =      922.072 in
Diameter                   =      132.000 in
Undrained cohesion, c      =      3.48000 lbs/in**2
Average Eff. Unit Weight   =      0.05275 lbs/in**3
Epsilon-50                 =      0.01100
Pct                        =     9403.142 lbs/in
Pcd                        =     4134.240 lbs/in
Pu                         =     4134.240 lbs/in
y50                        =        3.630 in
p-multiplier               =      1.00000
y-multiplier               =      1.00000

        y, in           p, lbs/in
----------------    -----------------
         0.0000            0.0000
      0.0005808          232.4854
      0.0029040          347.6468
      0.0058080          413.4240
      0.0290400          618.2131
      0.0580800          735.1834
      0.2904000         1099.3556
      0.5808000         1307.3615
         1.4520         1643.9200
         2.9040         1954.9614
         4.3560         2163.5205
         5.8080         2324.8540
        14.5200         2923.3491
        29.0400         3476.4676
        58.0800         4134.2400
        65.3400         4134.2400
        72.6000         4134.2400
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 221503.000 lbs
Specified moment at pile head = 235128000.000 in-lbs
Specified axial load at pile head = 117367.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	2.261	2.35E+08	2.22E+05	-0.008520	1049.893	1.47E+13	0.000	0.000
11.400	2.165	2.38E+08	2.22E+05	-0.008336	1061.126	1.47E+13	0.000	0.000
22.800	2.071	2.40E+08	2.22E+05	-0.008151	1072.358	1.47E+13	0.000	0.000
34.200	1.979	2.43E+08	2.22E+05	-0.007964	1083.588	1.47E+13	0.000	0.000
45.600	1.889	2.45E+08	2.01E+05	-0.007774	1094.818	1.47E+13	-3576.759	21583.
57.000	1.802	2.47E+08	1.52E+05	-0.007583	1103.988	1.47E+13	-4994.298	31601.
68.400	1.716	2.49E+08	86888.	-0.007390	1110.283	1.47E+13	-6474.595	43005.
79.800	1.633	2.49E+08	43758.	-0.007197	1112.849	1.47E+13	-1092.020	7622.669
91.200	1.552	2.50E+08	31031.	-0.007003	1114.786	1.47E+13	-1140.831	8378.630
102.600	1.473	2.50E+08	17772.	-0.006809	1116.066	1.47E+13	-1185.348	9170.708
114.000	1.397	2.50E+08	4024.179	-0.006614	1116.661	1.47E+13	-1226.476	10009.
125.400	1.323	2.50E+08	-10176.	-0.006420	1116.550	1.47E+13	-1264.746	10901.
136.800	1.251	2.50E+08	-24551.	-0.006226	1115.710	1.47E+13	-1257.137	11460.
148.200	1.181	2.50E+08	-39045.	-0.006032	1114.145	1.47E+13	-1285.788	12414.
159.600	1.113	2.49E+08	-53857.	-0.005838	1111.839	1.47E+13	-1312.709	13445.
171.000	1.048	2.48E+08	-68965.	-0.005645	1108.776	1.47E+13	-1337.913	14559.
182.400	0.984371	2.48E+08	-84351.	-0.005452	1104.942	1.47E+13	-1361.396	15766.
193.800	0.923310	2.47E+08	-99995.	-0.005260	1100.323	1.47E+13	-1383.149	17078.
205.200	0.864432	2.45E+08	-1.16E+05	-0.005070	1094.907	1.47E+13	-1403.156	18505.
216.600	0.807725	2.44E+08	-1.32E+05	-0.004880	1088.683	1.47E+13	-1419.733	20038.
228.000	0.753177	2.42E+08	-1.48E+05	-0.004691	1081.640	1.47E+13	-1395.132	21117.
239.400	0.700772	2.41E+08	-1.64E+05	-0.004504	1073.793	1.47E+13	-1370.204	22290.
250.800	0.650496	2.39E+08	-1.79E+05	-0.004318	1065.156	1.47E+13	-1344.938	23570.
262.200	0.602330	2.36E+08	-1.94E+05	-0.004133	1055.744	1.47E+13	-1319.319	24970.
273.600	0.556255	2.34E+08	-2.09E+05	-0.003951	1045.572	1.47E+13	-1293.331	26506.
285.000	0.512250	2.32E+08	-2.24E+05	-0.003770	1034.654	1.47E+13	-1266.957	28196.
296.400	0.470294	2.29E+08	-2.38E+05	-0.003592	1023.006	1.47E+13	-1240.177	30062.
307.800	0.430361	2.26E+08	-2.52E+05	-0.003415	1010.643	1.47E+13	-1212.970	32131.
319.200	0.392428	2.23E+08	-2.66E+05	-0.003241	997.581	1.47E+13	-1185.310	34433.
330.600	0.356467	2.20E+08	-2.79E+05	-0.003069	983.836	1.47E+13	-1157.169	37007.
342.000	0.322451	2.17E+08	-2.92E+05	-0.002900	969.423	1.47E+13	-1128.517	39898.
353.400	0.290350	2.14E+08	-3.05E+05	-0.002733	954.360	1.47E+13	-1099.317	43162.
364.800	0.260134	2.10E+08	-3.17E+05	-0.002569	938.664	1.47E+13	-1069.527	46871.
376.200	0.231770	2.06E+08	-3.29E+05	-0.002408	922.351	1.47E+13	-1039.099	51110.
387.600	0.205225	2.03E+08	-3.41E+05	-0.002250	905.438	1.47E+13	-1007.977	55992.
399.000	0.180466	1.99E+08	-3.52E+05	-0.002095	887.945	1.47E+13	-976.096	61660.
410.400	0.157457	1.94E+08	-3.63E+05	-0.001943	869.889	1.48E+13	-943.375	68301.
421.800	0.136161	1.90E+08	-3.74E+05	-0.001795	851.290	1.48E+13	-909.719	76166.
433.200	0.116540	1.86E+08	-3.84E+05	-0.001649	832.165	1.48E+13	-875.012	85594.
444.600	0.098557	1.82E+08	-3.94E+05	-0.001507	812.537	1.48E+13	-839.106	97059.
456.000	0.082170	1.77E+08	-4.03E+05	-0.001369	792.424	1.48E+13	-801.816	1.11E+05
467.400	0.067341	1.72E+08	-4.16E+05	-0.001234	771.849	1.48E+13	-1435.052	2.43E+05
478.800	0.054026	1.68E+08	-4.32E+05	-0.001103	750.448	1.48E+13	-1377.851	2.91E+05
490.200	0.042183	1.63E+08	-4.47E+05	-0.000976	728.253	1.48E+13	-1313.645	3.55E+05
501.600	0.031768	1.57E+08	-4.62E+05	-0.000853	705.300	1.48E+13	-1240.866	4.45E+05
513.000	0.022734	1.52E+08	-4.75E+05	-0.000734	681.633	1.48E+13	-1156.989	5.80E+05
524.400	0.015033	1.46E+08	-4.88E+05	-0.000619	657.300	1.48E+13	-1057.458	8.02E+05
535.800	0.008618	1.41E+08	-4.99E+05	-0.000509	632.357	1.48E+13	-932.391	1.23E+06
547.200	0.003437	1.35E+08	-5.09E+05	-0.000403	606.876	1.48E+13	-750.727	2.49E+06
558.600	-0.000560	1.29E+08	-5.12E+05	-0.000301	580.964	1.49E+13	151.089	3.07E+06
570.000	-0.003431	1.23E+08	-5.07E+05	-0.000240	555.137	6.08E+13	769.427	2.56E+06
581.400	-0.006037	1.18E+08	-4.98E+05	-0.000218	529.753	6.09E+13	897.350	1.69E+06
592.800	-0.008393	1.12E+08	-4.87E+05	-0.000196	504.886	6.09E+13	986.410	1.34E+06
604.200	-0.010509	1.07E+08	-4.75E+05	-0.000176	480.586	6.10E+13	1056.144	1.15E+06
615.600	-0.012399	1.01E+08	-4.63E+05	-0.000156	456.894	6.11E+13	1113.907	1.02E+06
627.000	-0.014073	9.60E+07	-4.50E+05	-0.000138	433.842	6.11E+13	1161.613	9.41E+05
638.400	-0.015543	9.10E+07	-4.37E+05	-0.000120	411.460	6.12E+13	1190.831	8.73E+05
649.800	-0.016819	8.61E+07	-4.23E+05	-0.000104	389.762	6.12E+13	1214.569	8.23E+05
661.200	-0.017913	8.13E+07	-4.09E+05	-8.84E-05	368.764	6.13E+13	1233.857	7.85E+05
672.600	-0.018835	7.67E+07	-3.99E+05	-7.37E-05	348.476	6.13E+13	554.778	3.36E+05
684.000	-0.019593	7.22E+07	-3.92E+05	-5.99E-05	328.506	6.14E+13	560.285	3.26E+05
695.400	-0.020199	6.78E+07	-3.86E+05	-4.69E-05	308.860	6.14E+13	564.568	3.19E+05
706.800	-0.020662	6.34E+07	-3.79E+05	-3.47E-05	289.538	6.15E+13	567.773	3.13E+05
718.200	-0.020990	5.92E+07	-3.73E+05	-2.33E-05	270.543	6.15E+13	570.016	3.10E+05
729.600	-0.021193	5.49E+07	-3.66E+05	-1.27E-05	251.876	6.16E+13	571.392	3.07E+05
741.000	-0.021281	5.08E+07	-3.56E+05	-2.96E-06	233.537	6.16E+13	1288.171	6.90E+05

```
 752.400 -0.021261  4.68E+07 -3.41E+05  6.06E-06   215.940  6.16E+13  1287.873  6.91E+05
 763.800 -0.021143  4.30E+07 -3.27E+05  1.44E-05   199.084  6.17E+13  1286.076  6.93E+05
 775.200 -0.020933  3.94E+07 -3.12E+05  2.20E-05   182.969  6.17E+13  1282.884  6.99E+05
 786.600 -0.020641  3.59E+07 -2.97E+05  2.89E-05   167.591  6.17E+13  1278.387  7.06E+05
 798.000 -0.020274  3.26E+07 -2.83E+05  3.53E-05   152.950  6.18E+13  1272.656  7.16E+05
 809.400 -0.019837  2.95E+07 -2.68E+05  4.10E-05   139.041  6.18E+13  1265.755  7.27E+05
 820.800 -0.019339  2.65E+07 -2.54E+05  4.61E-05   125.860  6.19E+13  1257.733  7.41E+05
 832.200 -0.018786  2.37E+07 -2.40E+05  5.08E-05   113.403  6.19E+13  1248.632  7.58E+05
 843.600 -0.018182  2.10E+07 -2.25E+05  5.49E-05   101.665  6.19E+13  1238.481  7.77E+05
 855.000 -0.017534  1.85E+07 -2.11E+05  5.85E-05    90.640  6.19E+13  1227.303  7.98E+05
 866.400 -0.016848  1.62E+07 -1.97E+05  6.17E-05    80.321  6.19E+13  1215.110  8.22E+05
 877.800 -0.016127  1.40E+07 -1.84E+05  6.45E-05    70.701  6.19E+13  1201.905  8.50E+05
 889.200 -0.015377  1.20E+07 -1.70E+05  6.69E-05    61.774  6.19E+13  1187.681  8.80E+05
 900.600 -0.014602  1.02E+07 -1.57E+05  6.89E-05    53.529  6.19E+13  1172.421  9.15E+05
 912.000 -0.013806  8.44E+06 -1.43E+05  7.06E-05    45.960  6.19E+13  1156.095  9.55E+05
 923.400 -0.012991  6.88E+06 -1.30E+05  7.21E-05    39.056  6.19E+13  1138.658  9.99E+05
 934.800 -0.012163  5.47E+06 -1.17E+05  7.32E-05    32.807  6.19E+13  1120.048  1.05E+06
 946.200 -0.011322  4.21E+06 -1.05E+05  7.41E-05    27.203  6.19E+13  1100.183  1.11E+06
 957.600 -0.010473  3.08E+06    -92300.  7.48E-05    22.232  6.19E+13  1078.951  1.17E+06
 969.000 -0.009618  2.10E+06    -80129.  7.52E-05    17.882  6.19E+13  1056.209  1.25E+06
 980.400 -0.008758  1.26E+06    -68228.  7.55E-05    14.140  6.19E+13  1031.766  1.34E+06
 991.800 -0.007895  5.45E+05    -56616.  7.57E-05    10.992  6.19E+13  1005.366  1.45E+06
   1003. -0.007032    -34826.    -45319.  7.58E-05     8.731  6.19E+13   976.665  1.58E+06
   1015. -0.006168 -4.88E+05    -34364.  7.57E-05    10.738  6.19E+13   945.188  1.75E+06
   1026. -0.005305 -8.19E+05    -23788.  7.56E-05    12.201  6.19E+13   910.252  1.96E+06
   1037. -0.004444 -1.03E+06    -13636.  7.54E-05    13.141  6.19E+13   870.841  2.23E+06
   1049. -0.003586 -1.13E+06 -3967.765  7.52E-05    13.579  6.19E+13   825.334  2.62E+06
   1060. -0.002729 -1.12E+06  5130.823  7.50E-05    13.542  6.19E+13   770.909  3.22E+06
   1072. -0.001875 -1.01E+06     12620.  7.48E-05    13.062  6.19E+13   543.062  3.30E+06
   1083. -0.001023 -8.34E+05     17405.  7.46E-05    12.269  6.19E+13   296.369  3.30E+06
   1094. -0.000173 -6.16E+05     19381.  7.45E-05    11.305  6.19E+13    50.183  3.30E+06
   1106.  0.000676 -3.92E+05     18552.  7.44E-05    10.313  6.19E+13  -195.628  3.30E+06
   1117.  0.001524 -1.93E+05     14922.  7.44E-05     9.433  6.19E+13  -441.200  3.30E+06
   1129.  0.002371    -52100.  8492.840  7.43E-05     8.807  6.19E+13  -686.655  3.30E+06
   1140.  0.003219     0.000     0.000  7.43E-05     8.576  6.19E+13  -803.317  1.42E+06
```

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     2.26083288 in
Computed slope at pile head      =    -0.00851974
Maximum bending moment           =   2.502043E+08 lbs-in
Maximum shear force              =  -512435.33537 lbs
Depth of maximum bending moment  =      114.00000 in
Depth of maximum shear force     =      558.60000 in
Number of iterations             =             69
Number of zero deflection points =              2
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 2.22E+05	M= 2.35E+08	117367.	2.2608	2.5020E+08	-512435.

The analysis ended normally.

B.10 Undrained Analysis from 6.0-in. Triaxial Test (Ultimate)

```
===============================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.47)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                            Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using 6 in Undrained Strengths.lpd
Name of output file:         Drilled Shaft Analysis Using 6 in Undrained Strengths.lpo
Name of plot output file:    Drilled Shaft Analysis Using 6 in Undrained Strengths.lpp
Name of runtime file:        Drilled Shaft Analysis Using 6 in Undrained Strengths.lpr


------------------------------------------------------------------------------
                          Time and Date of Analysis
------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:  13:07:29


------------------------------------------------------------------------------
                                Problem Title
------------------------------------------------------------------------------

Drilled Shaft Analysis:  Undrained Strengths Obtained from 6 in. Triaxial Test


------------------------------------------------------------------------------
                                Program Options
------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments           =         100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
```

```
- Maximum allowable deflection          =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


--------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                             =    1140.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface           =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
          in           in          in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000   14902723.   13685.0000      3604997.
  2    1140.0000     132.00000   14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  8 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       12.000 in
Distance from top of pile to bottom of layer =       72.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is stiff clay without free water
Distance from top of pile to top of layer    =      72.000 in
Distance from top of pile to bottom of layer =     132.000 in

Layer  3 is stiff clay without free water
Distance from top of pile to top of layer    =     132.000 in
Distance from top of pile to bottom of layer =     282.000 in

Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =     282.000 in
Distance from top of pile to bottom of layer =     396.000 in

Layer  5 is stiff clay without free water
Distance from top of pile to top of layer    =     396.000 in
Distance from top of pile to bottom of layer =     462.000 in

Layer  6 is stiff clay without free water
Distance from top of pile to top of layer    =     462.000 in
Distance from top of pile to bottom of layer =     672.000 in

Layer  7 is stiff clay without free water
Distance from top of pile to top of layer    =     672.000 in
Distance from top of pile to bottom of layer =     732.000 in

Layer  8 is stiff clay without free water
Distance from top of pile to top of layer    =     732.000 in
Distance from top of pile to bottom of layer =    1200.000 in


(Depth of lowest layer extends   60.00 in below pile tip)
```

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 16 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.03300
10	462.00	0.03300
11	462.00	0.03500
12	672.00	0.03500
13	672.00	0.03600
14	732.00	0.03600
15	732.00	0.03500
16	1200.00	0.03500

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	3.48000	0.00	------	------
4	132.000	3.48000	0.00	------	------
5	132.000	3.48000	0.00	------	------
6	282.000	3.48000	0.00	------	------
7	282.000	3.48000	0.00	------	------
8	396.000	3.48000	0.00	------	------
9	396.000	3.48000	0.00	------	------
10	462.000	3.48000	0.00	------	------
11	462.000	7.00000	0.00	------	------
12	672.000	7.00000	0.00	------	------
13	672.000	3.48000	0.00	------	------
14	732.000	3.48000	0.00	------	------
15	732.000	7.00000	0.00	------	------
16	1200.000	7.00000	0.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.001	1.0000	1.0000
4	1200.000	1.0000	1.0000

```
                                Loading Type
-------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.



-------------------------------------------------------------------------------
              Pile-head Loading and Pile-head Fixity Conditions
-------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =      319693.000 lbs
Bending moment at pile head =   345051000.000 in-lbs
Axial load at pile head     =      189766.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head
may rotate under the applied pile-head loading, but is not a free-head
(zero moment) condition.




-------------------------------------------------------------------------------
                   Output of p-y Curves at Specified Depths
-------------------------------------------------------------------------------



p-y curves are generated and printed for verification at  5 depths.

Depth      Depth Below Pile Head      Depth Below Ground Surface
 No.                in                           in
-----      ---------------------      --------------------------
  1              60.000                        48.000
  2             174.000                       162.000
  3             348.000                       336.000
  4             513.000                       501.000
  5             690.000                       678.000

Depth of ground surface below top of pile =      12.00 in



-------------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
-------------------------------------------------------------------------------

Number of sections =  1



Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                       =     132.0000 in

Material Properties:

Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =           90
Area of Single Bar                     =      1.56000 in**2
Number of Rows of Reinforcing Bars     =           45
Area of Steel                          =      140.400 in**2
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        1.026 percent
Cover Thickness (edge to bar center)   =        4.000 in

Unfactored Axial Squash Load Capacity  =     54474.89 kip

Distribution and Area of Steel Reinforcement

 Row          Area of       Distance to
Number     Reinforcement   Centroidal Axis
```

	in**2	in
1	3.120	61.962
2	3.120	61.660
3	3.120	61.058
4	3.120	60.158
5	3.120	58.966
6	3.120	57.485
7	3.120	55.725
8	3.120	53.694
9	3.120	51.400
10	3.120	48.857
11	3.120	46.075
12	3.120	43.069
13	3.120	39.853
14	3.120	36.443
15	3.120	32.855
16	3.120	29.107
17	3.120	25.218
18	3.120	21.205
19	3.120	17.090
20	3.120	12.891
21	3.120	8.629
22	3.120	4.325
23	3.120	0.000
24	3.120	-4.325
25	3.120	-8.629
26	3.120	-12.891
27	3.120	-17.090
28	3.120	-21.205
29	3.120	-25.218
30	3.120	-29.107
31	3.120	-32.855
32	3.120	-36.443
33	3.120	-39.853
34	3.120	-43.069
35	3.120	-46.075
36	3.120	-48.857
37	3.120	-51.400
38	3.120	-53.694
39	3.120	-55.725
40	3.120	-57.485
41	3.120	-58.966
42	3.120	-60.158
43	3.120	-61.058
44	3.120	-61.660
45	3.120	-61.962

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25787557.	6.189014E+13	4.166667E-07	0.00002759	66.21427399	97.94913580	751.29944
51348729.	6.161847E+13	8.333333E-07	0.00005518	66.21381372	194.46533	1502.58775
76683516.	6.134681E+13	0.00000125	0.00008277	66.21334952	289.54864	2253.86480
1.017919E+08	6.107515E+13	0.00000167	0.00011035	66.21287745	383.19907	3005.13026
1.266739E+08	6.080349E+13	0.00000208	0.00013794	66.21240145	475.41669	3756.38406
1.266739E+08	5.066957E+13	0.00000250	0.00008432	33.72696823	290.15987	6832.05657
1.266739E+08	4.343106E+13	0.00000292	0.00009843	33.74794382	337.47299	7968.95848
1.266739E+08	3.800218E+13	0.00000333	0.00011256	33.76901776	384.48442	9105.34397
1.266739E+08	3.377972E+13	0.00000375	0.00012671	33.79018611	431.19311	10241.20991
1.266739E+08	3.040174E+13	0.00000417	0.00014088	33.81144494	477.59798	11376.55335
1.266739E+08	2.763795E+13	0.00000458	0.00015507	33.83280605	523.69813	12511.36944
1.266739E+08	2.533479E+13	0.00000500	0.00016927	33.85425764	569.49235	13645.65618
1.266739E+08	2.338596E+13	0.00000542	0.00018349	33.87581152	614.97974	14779.40844
1.266739E+08	2.171553E+13	0.00000583	0.00019774	33.89746374	660.15918	15912.62317
1.266739E+08	2.026783E+13	0.00000625	0.00021200	33.91921431	705.02956	17045.29683
1.266739E+08	1.900109E+13	0.00000667	0.00022627	33.94106716	749.58988	18177.42506
1.266739E+08	1.788338E+13	0.00000708	0.00024057	33.96302229	793.83901	19309.00418
1.266739E+08	1.688986E+13	0.00000750	0.00025489	33.98507971	837.77583	20440.03047
1.266739E+08	1.600092E+13	0.00000792	0.00026922	34.00723940	881.39920	21570.50022
1.266739E+08	1.520087E+13	0.00000833	0.00028358	34.02950531	924.70806	22700.40877
1.298377E+08	1.483860E+13	0.00000875	0.00029795	34.05187351	967.70116	23829.75328
1.359483E+08	1.483072E+13	0.00000917	0.00031235	34.07435185	1010.37751	24958.52795
1.420519E+08	1.482281E+13	0.00000958	0.00032676	34.09693247	1052.73571	26086.73096
1.481487E+08	1.481487E+13	0.00001000	0.00034120	34.11962718	1094.77489	27214.35519
1.542385E+08	1.480690E+13	0.00001042	0.00035565	34.14242810	1136.49361	28341.39888
1.603213E+08	1.479889E+13	0.00001083	0.00037012	34.16534311	1177.89086	29467.85570

1.663972E+08	1.479086E+13	0.00001125	0.00038462	34.18836826	1218.96529	30593.72281
1.724659E+08	1.478279E+13	0.00001167	0.00039913	34.21150357	1259.71561	31718.99621
1.785276E+08	1.477470E+13	0.00001208	0.00041367	34.23475689	1300.14083	32843.66915
1.845821E+08	1.476657E+13	0.00001250	0.00042823	34.25812429	1340.23951	33967.73878
1.906294E+08	1.475840E+13	0.00001292	0.00044280	34.28160578	1380.01034	35091.20097
1.966694E+08	1.475021E+13	0.00001333	0.00045740	34.30520922	1419.45230	36214.04853
2.027022E+08	1.474198E+13	0.00001375	0.00047202	34.32892674	1458.56374	37336.28018
2.087276E+08	1.473371E+13	0.00001417	0.00048666	34.35276622	1497.34361	38457.88856
2.147457E+08	1.472542E+13	0.00001458	0.00050133	34.37672764	1535.79053	39578.86925
2.207563E+08	1.471709E+13	0.00001500	0.00051601	34.40081102	1573.90313	40699.21781
2.267594E+08	1.470872E+13	0.00001542	0.00053072	34.42501634	1611.67998	41818.92984
2.327551E+08	1.470032E+13	0.00001583	0.00054545	34.44934756	1649.11984	42937.99911
2.387431E+08	1.469189E+13	0.00001625	0.00056020	34.47380859	1686.22142	44056.41919
2.506963E+08	1.467491E+13	0.00001708	0.00058977	34.52310437	1759.40324	46291.30079
2.626186E+08	1.465778E+13	0.00001792	0.00061943	34.57292730	1831.21458	48523.52586
2.745096E+08	1.464051E+13	0.00001875	0.00064919	34.62328130	1901.64341	50753.05405
2.863689E+08	1.462309E+13	0.00001958	0.00067904	34.67417818	1970.67778	52979.84015
2.981959E+08	1.460551E+13	0.00002042	0.00070898	34.72562975	2038.30540	55203.83782
3.099903E+08	1.458778E+13	0.00002125	0.00073903	34.77764779	2104.51365	57424.99957
3.217517E+08	1.456989E+13	0.00002208	0.00076917	34.83025199	2169.28998	59643.27173
3.318757E+08	1.448185E+13	0.00002292	0.00079794	34.81911510	2229.47708	60000.00000
3.400568E+08	1.431818E+13	0.00002375	0.00082499	34.73645979	2284.58155	60000.00000
3.471128E+08	1.411984E+13	0.00002458	0.00085103	34.61807674	2336.29173	60000.00000
3.534069E+08	1.390453E+13	0.00002542	0.00087637	34.47995728	2385.38663	60000.00000
3.590686E+08	1.367881E+13	0.00002625	0.00090111	34.32786459	2432.16364	60000.00000
3.642042E+08	1.344754E+13	0.00002708	0.00092534	34.16629118	2476.87014	60000.00000
3.689177E+08	1.321496E+13	0.00002792	0.00094915	33.99947780	2519.75073	60000.00000
3.733099E+08	1.298469E+13	0.00002875	0.00097265	33.83145672	2561.04671	60000.00000
3.772405E+08	1.275179E+13	0.00002958	0.00099565	33.65590221	2600.46397	60000.00000
3.809654E+08	1.252489E+13	0.00003042	0.00101845	33.48322338	2638.57987	60000.00000
3.844461E+08	1.230227E+13	0.00003125	0.00104098	33.31151623	2675.33276	60000.00000
3.876586E+08	1.208287E+13	0.00003208	0.00106321	33.13913244	2710.67250	60000.00000
3.911079E+08	1.188176E+13	0.00003292	0.00108625	33.00000197	2746.41666	60000.00000
3.937652E+08	1.166712E+13	0.00003375	0.00111014	32.89313346	2782.53804	60000.00000
3.964202E+08	1.146275E+13	0.00003458	0.00113131	32.71251208	2813.51852	60000.00000
3.990118E+08	1.126622E+13	0.00003542	0.00115242	32.53885370	2843.62159	60000.00000
4.013191E+08	1.107087E+13	0.00003625	0.00117310	32.36138731	2872.31936	60000.00000
4.036190E+08	1.088411E+13	0.00003708	0.00119382	32.19288236	2900.30825	60000.00000
4.057795E+08	1.070188E+13	0.00003792	0.00121434	32.02646238	2927.26089	60000.00000
4.077671E+08	1.052302E+13	0.00003875	0.00123459	31.86037284	2953.11762	60000.00000
4.097479E+08	1.035153E+13	0.00003958	0.00125488	31.70215899	2978.29193	60000.00000
4.116459E+08	1.018505E+13	0.00004042	0.00127505	31.54766661	3002.59564	60000.00000
4.133489E+08	1.002058E+13	0.00004125	0.00129489	31.39131349	3025.77493	60000.00000
4.150456E+08	9.862470E+12	0.00004208	0.00131477	31.24194700	3048.29687	60000.00000
4.167360E+08	9.710353E+12	0.00004292	0.00133467	31.09916192	3070.15785	60000.00000
4.182788E+08	9.560659E+12	0.00004375	0.00135431	30.95572382	3091.02531	60000.00000
4.197250E+08	9.414393E+12	0.00004458	0.00137379	30.81404811	3111.04082	60000.00000
4.214537E+08	9.279714E+12	0.00004542	0.00139848	30.79215986	3135.68928	60000.00000
4.228530E+08	9.142767E+12	0.00004625	0.00141744	30.64725047	3153.66581	60000.00000
4.242068E+08	9.009703E+12	0.00004708	0.00143632	30.50595242	3170.94185	60000.00000
4.253891E+08	8.877686E+12	0.00004792	0.00145481	30.36126727	3187.22812	60000.00000
4.265665E+08	8.750082E+12	0.00004875	0.00147333	30.22214073	3202.93999	60000.00000
4.277391E+08	8.626670E+12	0.00004958	0.00149188	30.08830529	3218.07492	60000.00000
4.300423E+08	8.391070E+12	0.00005125	0.00152899	29.83397037	3246.54184	60000.00000
4.319998E+08	8.163775E+12	0.00005292	0.00156529	29.58030421	3272.01560	60000.00000
4.339391E+08	7.950030E+12	0.00005458	0.00160171	29.34428161	3295.25396	60000.00000
4.358387E+08	7.748243E+12	0.00005625	0.00163818	29.12314492	3316.19503	60000.00000
4.374438E+08	7.552987E+12	0.00005792	0.00167388	28.90152043	3334.41710	60000.00000
4.390320E+08	7.368369E+12	0.00005958	0.00170970	28.69422716	3350.45871	60000.00000
4.402956E+08	7.188499E+12	0.00006125	0.00175175	28.59999830	3366.54094	60000.00000
4.423675E+08	7.031007E+12	0.00006292	0.00178857	28.42768139	3377.97382	60000.00000
4.435896E+08	6.868484E+12	0.00006458	0.00182239	28.21769339	3386.34100	60000.00000
4.447974E+08	6.713923E+12	0.00006625	0.00185632	28.01991230	3392.73687	60000.00000
4.459908E+08	6.566735E+12	0.00006792	0.00189036	27.83346480	3397.14127	60000.00000
4.471696E+08	6.426389E+12	0.00006958	0.00192451	27.65756017	3399.53350	60000.00000
4.481224E+08	6.289437E+12	0.00007125	0.00195781	27.47809535	3397.47132	60000.00000
4.490422E+08	6.158293E+12	0.00007292	0.00199121	27.30801684	3389.13169	60000.00000
4.499549E+08	6.032915E+12	0.00007458	0.00202471	27.14700598	3391.89791	60000.00000
4.508604E+08	5.912923E+12	0.00007625	0.00205833	26.99448448	3396.12040	60000.00000
4.517586E+08	5.797971E+12	0.00007792	0.00209206	26.84993309	3398.81321	60000.00000
4.525539E+08	5.686541E+12	0.00007958	0.00212537	26.70626682	3399.95080	60000.00000
4.532662E+08	5.578661E+12	0.00008125	0.00215851	26.56622761	3394.58019	60000.00000
4.539711E+08	5.475028E+12	0.00008292	0.00219176	26.43325371	3387.24744	60000.00000
4.566183E+08	5.398443E+12	0.00008458	0.00223300	26.40000039	3389.86771	60000.00000
4.566183E+08	5.294125E+12	0.00008625	0.00227218	26.34416646	3394.95074	60000.00000
4.566183E+08	5.193763E+12	0.00008792	0.00230424	26.20940655	3397.64940	60000.00000
4.570244E+08	5.101667E+12	0.00008958	0.00233639	26.08061832	3399.33318	60000.00000
4.575943E+08	5.014732E+12	0.00009125	0.00236810	25.95172781	3399.98715	60000.00000
4.580891E+08	4.930106E+12	0.00009292	0.00239952	25.82438725	3395.08399	60000.00000
4.585803E+08	4.848426E+12	0.00009458	0.00243102	25.70242435	3389.18152	60000.00000
4.590626E+08	4.769482E+12	0.00009625	0.00246269	25.58640558	3383.23530	60000.00000

4.595137E+08	4.692906E+12	0.00009792	0.00249487	25.47953707	3383.82909	60000.00000
4.599284E+08	4.618528E+12	0.00009958	0.00252765	25.38221616	3388.44361	60000.00000
4.603406E+08	4.546574E+12	0.00010125	0.00256049	25.28880554	3392.29716	60000.00000
4.607281E+08	4.476710E+12	0.00010292	0.00259377	25.20262545	3395.42967	60000.00000
4.611002E+08	4.408926E+12	0.00010458	0.00262733	25.12186629	3397.77531	60000.00000
4.614027E+08	4.342614E+12	0.00010625	0.00266027	25.03787738	3399.25293	60000.00000
4.616766E+08	4.278084E+12	0.00010792	0.00269303	24.95468313	3399.94092	60000.00000
4.619204E+08	4.215243E+12	0.00010958	0.00272638	24.87949044	3396.63991	60000.00000
4.621507E+08	4.154163E+12	0.00011125	0.00276002	24.80915219	3391.14197	60000.00000
4.623791E+08	4.094870E+12	0.00011292	0.00279371	24.74138671	3385.62922	60000.00000
4.626060E+08	4.037289E+12	0.00011458	0.00282747	24.67609960	3380.10111	60000.00000
4.628311E+08	3.981343E+12	0.00011625	0.00286128	24.61317676	3375.27318	60000.00000
4.632524E+08	3.873887E+12	0.00011958	0.00292957	24.49814540	3385.00615	60000.00000
4.636336E+08	3.771934E+12	0.00012292	0.00299877	24.39679617	3392.47464	60000.00000
4.639854E+08	3.675132E+12	0.00012625	0.00306794	24.30050594	3397.39037	60000.00000
4.639854E+08	3.580595E+12	0.00012958	0.00313592	24.19999856	3399.72475	60000.00000
4.639854E+08	3.490799E+12	0.00013292	0.00321658	24.19999856	3391.85144	60000.00000
4.639854E+08	3.405398E+12	0.00013625	0.00329725	24.19999856	3379.25644	60000.00000
4.643191E+08	3.326465E+12	0.00013958	0.00337792	24.19999856	3368.17395	60000.00000
4.651442E+08	3.254653E+12	0.00014292	0.00345309	24.16152889	3379.25053	60000.00000
4.652853E+08	3.181438E+12	0.00014625	0.00352194	24.08165485	3386.56275	60000.00000
4.654226E+08	3.111460E+12	0.00014958	0.00359103	24.00687522	3392.33234	60000.00000
4.655350E+08	3.044370E+12	0.00015292	0.00366122	23.94255584	3396.62145	60000.00000
4.656271E+08	2.980014E+12	0.00015625	0.00373232	23.88687927	3399.22850	60000.00000
4.656924E+08	2.918177E+12	0.00015958	0.00380311	23.83151740	3399.39615	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 463639.80189 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number            =          1
Depth below pile head        =     60.000 in
Depth below ground surface   =     48.000 in
Equivalent Depth (see note)  =     48.000 in
Pile Diameter                =    132.000 in
Angle of Friction            =     46.000 deg.
Avg. Eff. Unit Weight        =    0.05300 pci
k                            =    225.000 pci
A (static)                   =     2.5755
B (static)                   =     1.9145
Pst                          =   2979.144 lbs/in
Psd                          =  82368.160 lbs/in
Ps                           =   2979.144 lbs/in
Cbar                         =  4587.6751
n                            =     3.6210
m                            =   715.9795
yk                           =     0.3064 in
pm                           =   5703.707 lbs/in
ym                           =     2.2000 in
pu                           =   7672.651 lbs/in
yu                           =     4.9500 in
p-multiplier                 =    1.00000
y-multiplier                 =    1.00000
```

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in	
0.0000	0.0000	
0.1833333	1980.0000	*
0.3666667	3477.4460	
0.5500000	3889.4693	
0.7333333	4211.0834	
0.9166667	4478.7502	
1.1000	4710.0313	
1.2833	4914.8701	
1.4667	5099.4965	
1.6500	5268.0968	
1.8333	5423.6329	
2.0167	5568.2847	
2.2000	5703.7075	
3.5750	6688.1793	
4.9500	7672.6512	
136.9500	7672.6512	
268.9500	7672.6512	

* p value(s) computed using p = k * Eff x * y

```
The above p-y curve was computed using the internal default value of k.



p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number            =          3
Depth below pile head        =      174.000 in
Depth below ground surface   =      162.000 in
Equivalent Depth             =      226.127 in
Diameter                     =      132.000 in
Undrained cohesion, c        =      3.48000 lbs/in**2
Average Eff. Unit Weight     =      0.06404 lbs/in**3
Epsilon-50                   =      0.01100
Pct                          =     3682.971 lbs/in
Pcd                          =     4134.240 lbs/in
Pu                           =     3682.971 lbs/in
y50                          =        3.630 in
p-multiplier                 =      1.00000
y-multiplier                 =      1.00000

        y, in            p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.0005808         207.1087
      0.0029040         309.6997
      0.0058080         368.2971
      0.0290400         550.7326
      0.0580800         654.9351
      0.2904000         979.3564
      0.5808000        1164.6576
         1.4520        1464.4794
         2.9040        1741.5693
         4.3560        1927.3633
         5.8080        2071.0866
        14.5200        2604.2536
        29.0400        3096.9969
        58.0800        3682.9707
        65.3400        3682.9707
        72.6000        3682.9707



p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number            =          4
Depth below pile head        =      348.000 in
Depth below ground surface   =      336.000 in
Equivalent Depth             =      394.435 in
Diameter                     =      132.000 in
Undrained cohesion, c        =      3.48000 lbs/in**2
Average Eff. Unit Weight     =      0.06616 lbs/in**3
Epsilon-50                   =      0.01100
Pct                          =     5509.082 lbs/in
Pcd                          =     4134.240 lbs/in
Pu                           =     4134.240 lbs/in
y50                          =        3.630 in
p-multiplier                 =      1.00000
y-multiplier                 =      1.00000

        y, in            p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.0005808         232.4854
      0.0029040         347.6468
      0.0058080         413.4240
      0.0290400         618.2131
      0.0580800         735.1834
      0.2904000        1099.3556
      0.5808000        1307.3615
         1.4520        1643.9200
         2.9040        1954.9614
         4.3560        2163.5205
         5.8080        2324.8540
        14.5200        2923.3491
        29.0400        3476.4676
```

```
        58.0800        4134.2400
        65.3400        4134.2400
        72.6000        4134.2400
```

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

```
Soil Layer Number            =          6
Depth below pile head        =      513.000 in
Depth below ground surface   =      501.000 in
Equivalent Depth             =      405.304 in
Diameter                     =      132.000 in
Undrained cohesion, c        =      7.00000 lbs/in**2
Average Eff. Unit Weight     =      0.05899 lbs/in**3
Epsilon-50                   =      0.00700
Pct                          =     7346.433 lbs/in
Pcd                          =     8316.000 lbs/in
Pu                           =     7346.433 lbs/in
y50                          =        2.310 in
p-multiplier                 =      1.00000
y-multiplier                 =      1.00000

        y, in            p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.0003696         413.1203
      0.0018480         617.7589
      0.0036960         734.6433
      0.0184800        1098.5480
      0.0369600        1306.4011
      0.1848000        1953.5253
      0.3696000        2323.1462
      0.9240000        2921.2017
         1.8480        3473.9138
         2.7720        3844.5177
         3.6960        4131.2031
         9.2400        5194.7128
        18.4800        6177.5894
        36.9600        7346.4333
        41.5800        7346.4333
        46.2000        7346.4333
```

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

```
Soil Layer Number            =          7
Depth below pile head        =      690.000 in
Depth below ground surface   =      678.000 in
Equivalent Depth             =      922.072 in
Diameter                     =      132.000 in
Undrained cohesion, c        =      3.48000 lbs/in**2
Average Eff. Unit Weight     =      0.05275 lbs/in**3
Epsilon-50                   =      0.01100
Pct                          =     9403.142 lbs/in
Pcd                          =     4134.240 lbs/in
Pu                           =     4134.240 lbs/in
y50                          =        3.630 in
p-multiplier                 =      1.00000
y-multiplier                 =      1.00000

        y, in            p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.0005808         232.4854
      0.0029040         347.6468
      0.0058080         413.4240
      0.0290400         618.2131
      0.0580800         735.1834
      0.2904000        1099.3556
      0.5808000        1307.3615
         1.4520        1643.9200
         2.9040        1954.9614
         4.3560        2163.5205
         5.8080        2324.8540
        14.5200        2923.3491
```

29.0400	3476.4676
58.0800	4134.2400
65.3400	4134.2400
72.6000	4134.2400

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 319693.000 lbs
Specified moment at pile head = 345051000.000 in-lbs
Specified axial load at pile head = 189766.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	4.622	3.45E+08	3.20E+05	-0.015360	1542.001	1.41E+13	0.000	0.000
11.400	4.449	3.49E+08	3.20E+05	-0.015079	1558.288	1.41E+13	0.000	0.000
22.800	4.279	3.52E+08	3.20E+05	-0.014795	1574.571	1.41E+13	0.000	0.000
34.200	4.112	3.56E+08	3.20E+05	-0.014505	1590.852	1.38E+13	0.000	0.000
45.600	3.948	3.60E+08	2.94E+05	-0.014207	1607.130	1.36E+13	-4527.340	13073.
57.000	3.788	3.63E+08	2.32E+05	-0.013904	1620.799	1.35E+13	-6322.917	19031.
68.400	3.631	3.65E+08	1.49E+05	-0.013596	1630.827	1.34E+13	-8203.405	25756.
79.800	3.478	3.66E+08	94962.	-0.013284	1636.130	1.33E+13	-1319.152	4324.251
91.200	3.328	3.67E+08	79574.	-0.012970	1640.670	1.33E+13	-1380.475	4728.761
102.600	3.182	3.68E+08	63515.	-0.012654	1644.413	1.33E+13	-1436.917	5148.035
114.000	3.040	3.69E+08	46834.	-0.012336	1647.326	1.32E+13	-1489.572	5586.791
125.400	2.901	3.69E+08	29571.	-0.012018	1649.378	1.32E+13	-1539.089	6048.773
136.800	2.766	3.70E+08	12060.	-0.011699	1650.542	1.32E+13	-1533.012	6319.398
148.200	2.634	3.70E+08	-5635.313	-0.011379	1650.820	1.32E+13	-1571.385	6801.076
159.600	2.506	3.69E+08	-23758.	-0.011059	1650.191	1.32E+13	-1607.994	7314.698
171.000	2.382	3.69E+08	-42288.	-0.010740	1648.633	1.32E+13	-1642.866	7863.195
182.400	2.261	3.69E+08	-61205.	-0.010422	1646.127	1.32E+13	-1676.015	8449.769
193.800	2.144	3.68E+08	-80491.	-0.010105	1642.653	1.33E+13	-1707.445	9077.945
205.200	2.031	3.67E+08	-1.00E+05	-0.009790	1638.193	1.33E+13	-1737.153	9751.624
216.600	1.921	3.66E+08	-1.20E+05	-0.009478	1632.730	1.34E+13	-1763.070	10463.
228.000	1.815	3.64E+08	-1.40E+05	-0.009168	1626.250	1.35E+13	-1738.164	10919.
239.400	1.712	3.62E+08	-1.60E+05	-0.008861	1618.766	1.35E+13	-1713.018	11407.
250.800	1.613	3.60E+08	-1.79E+05	-0.008557	1610.293	1.36E+13	-1687.626	11930.
262.200	1.517	3.58E+08	-1.98E+05	-0.008257	1600.847	1.37E+13	-1661.976	12491.
273.600	1.424	3.56E+08	-2.17E+05	-0.007961	1590.440	1.38E+13	-1636.057	13094.
285.000	1.335	3.53E+08	-2.35E+05	-0.007669	1579.090	1.39E+13	-1609.855	13744.
296.400	1.250	3.51E+08	-2.54E+05	-0.007381	1566.810	1.40E+13	-1583.355	14445.
307.800	1.167	3.48E+08	-2.72E+05	-0.007098	1553.615	1.41E+13	-1556.540	15205.
319.200	1.088	3.44E+08	-2.89E+05	-0.006819	1539.523	1.42E+13	-1529.390	16029.
330.600	1.012	3.41E+08	-3.06E+05	-0.006545	1524.547	1.43E+13	-1501.885	16926.
342.000	0.938500	3.38E+08	-3.23E+05	-0.006275	1508.704	1.44E+13	-1474.000	17905.
353.400	0.868494	3.34E+08	-3.40E+05	-0.006009	1492.011	1.44E+13	-1445.707	18977.
364.800	0.801491	3.30E+08	-3.56E+05	-0.005748	1474.483	1.45E+13	-1416.979	20154.
376.200	0.737444	3.26E+08	-3.72E+05	-0.005490	1456.137	1.45E+13	-1387.781	21453.
387.600	0.676309	3.21E+08	-3.88E+05	-0.005237	1436.989	1.46E+13	-1358.078	22892.
399.000	0.618040	3.17E+08	-4.03E+05	-0.004987	1417.058	1.46E+13	-1327.830	24492.
410.400	0.562596	3.12E+08	-4.18E+05	-0.004742	1396.360	1.46E+13	-1296.992	26281.
421.800	0.509933	3.07E+08	-4.33E+05	-0.004499	1374.913	1.46E+13	-1265.512	28292.
433.200	0.460008	3.02E+08	-4.47E+05	-0.004261	1352.735	1.46E+13	-1233.330	30565.
444.600	0.412773	2.97E+08	-4.61E+05	-0.004027	1329.845	1.46E+13	-1200.372	33152.
456.000	0.368183	2.92E+08	-4.74E+05	-0.003798	1306.263	1.46E+13	-1166.550	36120.
467.400	0.326187	2.86E+08	-4.93E+05	-0.003572	1282.006	1.46E+13	-2128.902	74403.
478.800	0.286737	2.81E+08	-5.17E+05	-0.003351	1256.522	1.46E+13	-2091.274	83144.
490.200	0.249778	2.75E+08	-5.41E+05	-0.003135	1229.833	1.46E+13	-2049.122	93523.
501.600	0.215257	2.68E+08	-5.64E+05	-0.002924	1201.962	1.46E+13	-2001.937	1.06E+05
513.000	0.183116	2.62E+08	-5.87E+05	-0.002718	1172.937	1.47E+13	-1949.043	1.21E+05
524.400	0.153295	2.55E+08	-6.08E+05	-0.002517	1142.788	1.47E+13	-1889.525	1.41E+05
535.800	0.125732	2.48E+08	-6.30E+05	-0.002322	1111.549	1.47E+13	-1822.085	1.65E+05
547.200	0.100364	2.41E+08	-6.50E+05	-0.002132	1079.260	1.47E+13	-1744.805	1.98E+05
558.600	0.077124	2.33E+08	-6.69E+05	-0.001948	1045.965	1.47E+13	-1654.657	2.45E+05
570.000	0.055945	2.25E+08	-6.88E+05	-0.001771	1011.716	1.47E+13	-1546.404	3.15E+05
581.400	0.036756	2.17E+08	-7.04E+05	-0.001599	976.575	1.47E+13	-1409.624	4.37E+05
592.800	0.019486	2.09E+08	-7.19E+05	-0.001434	940.622	1.47E+13	-1217.593	7.12E+05
604.200	0.004062	2.01E+08	-7.31E+05	-0.001275	903.966	1.47E+13	-832.439	2.34E+06
615.600	-0.009591	1.93E+08	-7.30E+05	-0.001123	866.829	1.48E+13	1044.869	1.24E+06
627.000	-0.021547	1.84E+08	-7.17E+05	-0.000978	830.292	1.48E+13	1292.296	6.84E+05
638.400	-0.031881	1.76E+08	-7.01E+05	-0.000838	794.498	1.48E+13	1425.236	5.10E+05
649.800	-0.040665	1.68E+08	-6.84E+05	-0.000706	759.523	1.48E+13	1514.619	4.25E+05

661.200	-0.047969	1.61E+08	-6.67E+05	-0.000579	725.418	1.48E+13	1578.468	3.75E+05
672.600	-0.053862	1.53E+08	-6.54E+05	-0.000458	692.221	1.48E+13	721.476	1.53E+05
684.000	-0.058411	1.46E+08	-6.45E+05	-0.000343	659.437	1.48E+13	736.247	1.44E+05
695.400	-0.061681	1.38E+08	-6.37E+05	-0.000234	627.077	1.48E+13	746.342	1.38E+05
706.800	-0.063738	1.31E+08	-6.28E+05	-0.000130	595.144	1.48E+13	752.486	1.35E+05
718.200	-0.064645	1.24E+08	-6.20E+05	-6.79E-05	563.645	6.08E+13	755.148	1.33E+05
729.600	-0.065287	1.17E+08	-6.11E+05	-4.53E-05	532.579	6.09E+13	757.015	1.32E+05
741.000	-0.065679	1.10E+08	-5.97E+05	-2.41E-05	501.949	6.10E+13	1707.443	2.96E+05
752.400	-0.065836	1.04E+08	-5.77E+05	-4.11E-06	472.301	6.11E+13	1708.461	2.96E+05
763.800	-0.065772	9.70E+07	-5.58E+05	1.46E-05	443.637	6.11E+13	1708.048	2.96E+05
775.200	-0.065503	9.08E+07	-5.39E+05	3.21E-05	415.955	6.12E+13	1706.293	2.97E+05
786.600	-0.065040	8.48E+07	-5.19E+05	4.85E-05	389.256	6.12E+13	1703.270	2.99E+05
798.000	-0.064397	7.90E+07	-5.00E+05	6.37E-05	363.536	6.13E+13	1699.047	3.01E+05
809.400	-0.063588	7.34E+07	-4.80E+05	7.79E-05	338.795	6.14E+13	1693.679	3.04E+05
820.800	-0.062622	6.80E+07	-4.61E+05	9.10E-05	315.028	6.14E+13	1687.213	3.07E+05
832.200	-0.061513	6.29E+07	-4.42E+05	0.000103	292.232	6.15E+13	1679.691	3.11E+05
843.600	-0.060271	5.79E+07	-4.23E+05	0.000114	270.402	6.15E+13	1671.147	3.16E+05
855.000	-0.058907	5.32E+07	-4.04E+05	0.000125	249.535	6.16E+13	1661.607	3.22E+05
866.400	-0.057431	4.87E+07	-3.85E+05	0.000134	229.623	6.16E+13	1651.093	3.28E+05
877.800	-0.055851	4.44E+07	-3.66E+05	0.000143	210.662	6.17E+13	1639.621	3.35E+05
889.200	-0.054178	4.04E+07	-3.48E+05	0.000150	192.644	6.17E+13	1627.200	3.42E+05
900.600	-0.052420	3.65E+07	-3.29E+05	0.000158	175.563	6.17E+13	1613.834	3.51E+05
912.000	-0.050585	3.29E+07	-3.11E+05	0.000164	159.411	6.18E+13	1599.520	3.60E+05
923.400	-0.048681	2.94E+07	-2.93E+05	0.000170	144.179	6.18E+13	1584.249	3.71E+05
934.800	-0.046715	2.62E+07	-2.75E+05	0.000175	129.859	6.19E+13	1568.005	3.83E+05
946.200	-0.044694	2.32E+07	-2.57E+05	0.000179	116.442	6.19E+13	1550.762	3.96E+05
957.600	-0.042625	2.03E+07	-2.39E+05	0.000183	103.917	6.19E+13	1532.487	4.10E+05
969.000	-0.040513	1.77E+07	-2.22E+05	0.000187	92.274	6.19E+13	1513.135	4.26E+05
980.400	-0.038363	1.53E+07	-2.05E+05	0.000190	81.502	6.19E+13	1492.650	4.44E+05
991.800	-0.036182	1.30E+07	-1.88E+05	0.000193	71.588	6.19E+13	1470.958	4.63E+05
1003.	-0.033973	1.10E+07	-1.71E+05	0.000195	62.522	6.19E+13	1447.971	4.86E+05
1015.	-0.031741	9.13E+06	-1.55E+05	0.000197	54.289	6.19E+13	1423.575	5.11E+05
1026.	-0.029490	7.45E+06	-1.39E+05	0.000198	46.875	6.19E+13	1397.629	5.40E+05
1037.	-0.027223	5.96E+06	-1.23E+05	0.000199	40.266	6.19E+13	1369.954	5.74E+05
1049.	-0.024944	4.65E+06	-1.08E+05	0.000200	34.445	6.19E+13	1340.325	6.13E+05
1060.	-0.022655	3.51E+06	-92519.	0.000201	29.395	6.19E+13	1308.449	6.58E+05
1072.	-0.020359	2.54E+06	-77799.	0.000202	25.099	6.19E+13	1273.941	7.13E+05
1083.	-0.018057	1.73E+06	-63491.	0.000202	21.536	6.19E+13	1236.285	7.81E+05
1094.	-0.015752	1.09E+06	-49634.	0.000202	18.684	6.19E+13	1194.766	8.65E+05
1106.	-0.013444	5.99E+05	-36278.	0.000202	16.520	6.19E+13	1148.354	9.74E+05
1117.	-0.011135	2.60E+05	-23488.	0.000203	15.017	6.19E+13	1095.485	1.12E+06
1129.	-0.008826	62692.	-11352.	0.000203	14.144	6.19E+13	1033.601	1.34E+06
1140.	-0.006516	0.000	0.000	0.000203	13.867	6.19E+13	958.041	8.38E+05

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection            =     4.62240804 in
Computed slope at pile head     =    -0.01536006
Maximum bending moment          =   3.696222E+08 lbs-in
Maximum shear force             =  -731044.92829 lbs
Depth of maximum bending moment =      148.20000 in
Depth of maximum shear force    =      604.20000 in
Number of iterations            =             50
Number of zero deflection points =             1
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

```
Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection   Moment      Shear
         1            2             lbs         in        in-lbs      lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  3.20E+05 M=  3.45E+08     189766.      4.6224  3.6962E+08    -731045.

The analysis ended normally.
```

B.11 Drained Analysis from CPT (Service)

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.47)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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                             All Rights Reserved

================================================================================

This program is licensed to:

Zach McClellan
University Of Utah

--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using CPT Friction Angles.lpd
Name of output file:         Drilled Shaft Analysis Using CPT Friction Angles.lpo
Name of plot output file:    Drilled Shaft Analysis Using CPT Friction Angles.lpp
Name of runtime file:        Drilled Shaft Analysis Using CPT Friction Angles.lpr


------------------------------------------------------------------------------
                          Time and Date of Analysis
------------------------------------------------------------------------------

              Date:  October 11, 2012     Time:  10:53:16


------------------------------------------------------------------------------
                                Problem Title
------------------------------------------------------------------------------

Drilled Shaft Analysis Using  CPT based Friction Angles


------------------------------------------------------------------------------
                                Program Options
------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths
```

```
Solution Control Parameters:
- Number of pile increments           =         100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


-------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
-------------------------------------------------------------------------------

Pile Length                               =     336.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface             =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
           in           in         in**4         Sq.in     lbs/Sq.in
-----  ----------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000    14902723.   13685.0000      3604997.
  2     336.0000     132.00000    14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.


-------------------------------------------------------------------------------
                      Soil and Rock Layering Information
-------------------------------------------------------------------------------

The soil profile is modelled using  5 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      12.000 in
Distance from top of pile to bottom of layer =      72.000 in
p-y subgrade modulus k for top of soil layer =       0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =       0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      72.000 in
Distance from top of pile to bottom of layer =     132.000 in
p-y subgrade modulus k for top of soil layer =       0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =       0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =     132.000 in
Distance from top of pile to bottom of layer =     282.000 in
p-y subgrade modulus k for top of soil layer =       0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =       0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =     282.000 in
Distance from top of pile to bottom of layer =     396.000 in
p-y subgrade modulus k for top of soil layer =       0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =       0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  5 is sand, p-y criteria by Reese et al., 1974
```

```
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      492.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.


(Depth of lowest layer extends  156.00 in below pile tip)


-------------------------------------------------------------------------------
                   Effective Unit Weight of Soil vs. Depth
-------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 10 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           12.00        0.05300
  2           72.00        0.05300
  3           72.00        0.07300
  4          132.00        0.07300
  5          132.00        0.06700
  6          282.00        0.06700
  7          282.00        0.07000
  8          396.00        0.07000
  9          396.00        0.06900
 10          492.00        0.06900



-------------------------------------------------------------------------------
                           Shear Strength of Soils
-------------------------------------------------------------------------------

Shear strength parameters with depth defined using 10 points

Point    Depth X     Cohesion c     Angle of Friction     E50 or      RQD
 No.       in        lbs/in**2            Deg.             k_rm        %
-----   --------    ----------     ------------------    ------     ------
  1      12.000       0.00000           46.00            ------     ------
  2      72.000       0.00000           46.00            ------     ------
  3      72.000       0.00000           48.00            ------     ------
  4     132.000       0.00000           48.00            ------     ------
  5     132.000       0.00000           48.00            ------     ------
  6     282.000       0.00000           48.00            ------     ------
  7     282.000       0.00000           48.00            ------     ------
  8     396.000       0.00000           48.00            ------     ------
  9     396.000       0.00000           48.00            ------     ------
 10     492.000       0.00000           48.00            ------     ------

Notes:

(1)  Cohesion = uniaxial compressive strength for rock materials.
(2)  Values of E50 are reported for clay strata.
(3)  Default values will be generated for E50 when input values are 0.
(4)  RQD and k_rm are reported only for weak rock strata.



-------------------------------------------------------------------------------
                           p-y Modification Factors
-------------------------------------------------------------------------------

Distribution of p-y multipliers with depth defined using  4 points

Point      Depth X         p-mult         y-mult
 No.        in
-----     ----------     ----------     ----------
  1          12.000         0.0000         1.0000
  2          42.000         0.0000         1.0000
  3          42.000         1.0000         1.0000
  4        1200.000         1.0000         1.0000


-------------------------------------------------------------------------------
```

```
                                Loading Type
-------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.


-------------------------------------------------------------------------------
              Pile-head Loading and Pile-head Fixity Conditions
-------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =      221503.000 lbs
Bending moment at pile head =   235128000.000 in-lbs
Axial load at pile head     =      117367.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head
may rotate under the applied pile-head loading, but is not a free-head
(zero moment) condition.



-------------------------------------------------------------------------------
                   Output of p-y Curves at Specified Depths
-------------------------------------------------------------------------------



p-y curves are generated and printed for verification at  2 depths.

Depth      Depth Below Pile Head      Depth Below Ground Surface
 No.                in                           in
-----      ---------------------      --------------------------
  1              60.000                        48.000
  2             174.000                       162.000

Depth of ground surface below top of pile =      12.00 in



-------------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
-------------------------------------------------------------------------------

Number of sections =  1



Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                       =     132.0000 in

Material Properties:

Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =           90
Area of Single Bar                     =      1.27000 in**2
Number of Rows of Reinforcing Bars     =           45
Area of Steel                          =      114.300 in**2
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        0.835 percent
Cover Thickness (edge to bar center)   =        4.000 in

Unfactored Axial Squash Load Capacity  =     52997.63 kip

Distribution and Area of Steel Reinforcement

 Row          Area of       Distance to
Number     Reinforcement   Centroidal Axis
               in**2             in
------     -------------   ---------------
   1           2.540            61.962
```

2	2.540	61.660
3	2.540	61.058
4	2.540	60.158
5	2.540	58.966
6	2.540	57.485
7	2.540	55.725
8	2.540	53.694
9	2.540	51.400
10	2.540	48.857
11	2.540	46.075
12	2.540	43.069
13	2.540	39.853
14	2.540	36.443
15	2.540	32.855
16	2.540	29.107
17	2.540	25.218
18	2.540	21.205
19	2.540	17.090
20	2.540	12.891
21	2.540	8.629
22	2.540	4.325
23	2.540	0.000
24	2.540	-4.325
25	2.540	-8.629
26	2.540	-12.891
27	2.540	-17.090
28	2.540	-21.205
29	2.540	-25.218
30	2.540	-29.107
31	2.540	-32.855
32	2.540	-36.443
33	2.540	-39.853
34	2.540	-43.069
35	2.540	-46.075
36	2.540	-48.857
37	2.540	-51.400
38	2.540	-53.694
39	2.540	-55.725
40	2.540	-57.485
41	2.540	-58.966
42	2.540	-60.158
43	2.540	-61.058
44	2.540	-61.660
45	2.540	-61.962

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25181408.	6.043538E+13	4.166667E-07	0.00002759	66.21742111	97.95383531	751.33747
50136430.	6.016372E+13	8.333333E-07	0.00005518	66.21697265	194.47463	1502.66409
74865067.	5.989205E+13	0.00000125	0.00008277	66.21652025	289.56242	2253.97974
99367320.	5.962039E+13	0.00000167	0.00011036	66.21605998	383.21724	3005.28408
1.236432E+08	5.934873E+13	0.00000208	0.00013795	66.21559578	475.43913	3756.57705
1.236432E+08	4.945727E+13	0.00000250	0.00007949	31.79650587	273.35193	6972.01509
1.236432E+08	4.239195E+13	0.00000292	0.00009280	31.81586856	317.99257	8132.37985
1.236432E+08	3.709296E+13	0.00000333	0.00010612	31.83531779	362.36870	9292.26830
1.236432E+08	3.297152E+13	0.00000375	0.00011946	31.85484964	406.47939	10451.67775
1.236432E+08	2.967436E+13	0.00000417	0.00013281	31.87446803	450.32382	11610.60473
1.236432E+08	2.697670E+13	0.00000458	0.00014618	31.89417690	493.90115	12769.04556
1.236432E+08	2.472864E+13	0.00000500	0.00015957	31.91396838	537.21037	13926.99812
1.236432E+08	2.282643E+13	0.00000542	0.00017298	31.93385428	580.25077	15084.45755
1.236432E+08	2.119597E+13	0.00000583	0.00018640	31.95382673	623.02128	16241.42177
1.236432E+08	1.978291E+13	0.00000625	0.00019984	31.97388965	665.52107	17397.88692
1.236432E+08	1.854648E+13	0.00000667	0.00021329	31.99404305	707.74918	18553.84972
1.236432E+08	1.745551E+13	0.00000708	0.00022677	32.01428694	749.70467	19709.30690
1.236432E+08	1.648576E+13	0.00000750	0.00024026	32.03462523	791.38666	20864.25431
1.236432E+08	1.561809E+13	0.00000792	0.00025377	32.05505794	832.79420	22018.68854
1.236432E+08	1.483718E+13	0.00000833	0.00026730	32.07558507	873.92631	23172.60617
1.236432E+08	1.413065E+13	0.00000875	0.00028084	32.09620661	914.78199	24326.00376
1.236432E+08	1.348835E+13	0.00000917	0.00029441	32.11692256	955.36025	25478.87790
1.236432E+08	1.290190E+13	0.00000958	0.00030799	32.13773686	995.66017	26631.22407
1.253513E+08	1.253513E+13	0.00001000	0.00032159	32.15864950	1035.68073	27783.03871
1.305096E+08	1.252892E+13	0.00001042	0.00033520	32.17966443	1075.42102	28934.31707
1.356625E+08	1.252269E+13	0.00001083	0.00034884	32.20077378	1114.87976	30085.05790
1.408098E+08	1.251643E+13	0.00001125	0.00036250	32.22198540	1154.05612	31235.25522
1.459517E+08	1.251015E+13	0.00001167	0.00037617	32.24330324	1192.94917	32384.90399
1.510881E+08	1.250384E+13	0.00001208	0.00038987	32.26471943	1231.55756	33534.00311

1.562189E+08	1.249751E+13	0.00001250	0.00040358	32.28624183	1269.88047	34682.54617
1.613441E+08	1.249116E+13	0.00001292	0.00041731	32.30786651	1307.91664	35830.53080
1.664637E+08	1.248477E+13	0.00001333	0.00043106	32.32959741	1345.66510	36977.95176
1.715776E+08	1.247837E+13	0.00001375	0.00044483	32.35143453	1383.12470	38124.80520
1.766858E+08	1.247194E+13	0.00001417	0.00045862	32.37338179	1420.29446	39271.08566
1.817883E+08	1.246548E+13	0.00001458	0.00047243	32.39543921	1457.17321	40416.78915
1.868850E+08	1.245900E+13	0.00001500	0.00048626	32.41760284	1493.75962	41561.91337
1.919759E+08	1.245249E+13	0.00001542	0.00050011	32.43988055	1530.05281	42706.45097
1.970610E+08	1.244596E+13	0.00001583	0.00051399	32.46227235	1566.05158	43850.39781
2.021402E+08	1.243940E+13	0.00001625	0.00052788	32.48477429	1601.75456	44993.75160
2.122808E+08	1.242619E+13	0.00001708	0.00055572	32.53012437	1672.26881	47278.65630
2.223975E+08	1.241288E+13	0.00001792	0.00058365	32.57594651	1741.58621	49561.12379
2.324898E+08	1.239946E+13	0.00001875	0.00061167	32.62224466	1809.69661	51841.11772
2.425576E+08	1.238592E+13	0.00001958	0.00063977	32.66903061	1876.59000	54118.59688
2.526004E+08	1.237227E+13	0.00002042	0.00066796	32.71631223	1942.25590	56393.52123
2.626180E+08	1.235850E+13	0.00002125	0.00069624	32.76410919	2006.68416	58665.84273
2.721121E+08	1.232206E+13	0.00002208	0.00072411	32.78967565	2068.72058	60000.00000
2.795383E+08	1.219804E+13	0.00002292	0.00074996	32.72565132	2124.87068	60000.00000
2.858830E+08	1.203718E+13	0.00002375	0.00077475	32.62121004	2177.48620	60000.00000
2.913909E+08	1.185319E+13	0.00002458	0.00079869	32.48905045	2227.16671	60000.00000
2.963306E+08	1.165891E+13	0.00002542	0.00082203	32.34232360	2274.58154	60000.00000
3.007969E+08	1.145893E+13	0.00002625	0.00084487	32.18566364	2319.98265	60000.00000
3.048770E+08	1.125700E+13	0.00002708	0.00086729	32.02311462	2363.60474	60000.00000
3.086357E+08	1.105561E+13	0.00002792	0.00088936	31.85755616	2405.62971	60000.00000
3.120117E+08	1.085258E+13	0.00002875	0.00091096	31.68568772	2445.90409	60000.00000
3.151933E+08	1.065442E+13	0.00002958	0.00093235	31.51608127	2484.93178	60000.00000
3.181679E+08	1.046031E+13	0.00003042	0.00095350	31.34785169	2522.69974	60000.00000
3.208838E+08	1.026828E+13	0.00003125	0.00097431	31.17791480	2559.06830	60000.00000
3.235065E+08	1.008332E+13	0.00003208	0.00099503	31.01396137	2594.50546	60000.00000
3.258804E+08	9.900165E+12	0.00003292	0.00101541	30.84788758	2628.58566	60000.00000
3.283735E+08	9.729584E+12	0.00003375	0.00103936	30.79570431	2667.96070	60000.00000
3.305070E+08	9.556830E+12	0.00003458	0.00105898	30.62122375	2699.19589	60000.00000
3.324844E+08	9.387796E+12	0.00003542	0.00107837	30.44806498	2729.35608	60000.00000
3.344561E+08	9.226374E+12	0.00003625	0.00109779	30.28375357	2758.90365	60000.00000
3.361933E+08	9.065887E+12	0.00003708	0.00111678	30.11552793	2787.13879	60000.00000
3.378986E+08	8.911611E+12	0.00003792	0.00113576	29.95411187	2814.70462	60000.00000
3.395986E+08	8.763835E+12	0.00003875	0.00115477	29.80043381	2841.68159	60000.00000
3.410842E+08	8.616863E+12	0.00003958	0.00117336	29.64275891	2867.42591	60000.00000
3.425468E+08	8.475384E+12	0.00004042	0.00119194	29.49135464	2892.54946	60000.00000
3.440045E+08	8.339502E+12	0.00004125	0.00121055	29.34677964	2917.10627	60000.00000
3.453646E+08	8.206683E+12	0.00004208	0.00122898	29.20355004	2940.80774	60000.00000
3.466128E+08	8.076414E+12	0.00004292	0.00124719	29.06078070	2963.62760	60000.00000
3.478564E+08	7.951003E+12	0.00004375	0.00126543	28.92408925	2985.90138	60000.00000
3.490955E+08	7.830178E+12	0.00004458	0.00128369	28.79314131	3007.62660	60000.00000
3.502570E+08	7.712081E+12	0.00004542	0.00130180	28.66357809	3028.57976	60000.00000
3.506722E+08	7.582101E+12	0.00004625	0.00132275	28.59999830	3052.26388	60000.00000
3.526325E+08	7.489539E+12	0.00004708	0.00134318	28.52766949	3074.58539	60000.00000
3.536482E+08	7.380485E+12	0.00004792	0.00136049	28.39274830	3092.76550	60000.00000
3.546602E+08	7.275081E+12	0.00004875	0.00137782	28.26298445	3110.45125	60000.00000
3.555833E+08	7.171429E+12	0.00004958	0.00139492	28.13280362	3127.36882	60000.00000
3.572817E+08	6.971350E+12	0.00005125	0.00142876	27.87832314	3159.33829	60000.00000
3.589660E+08	6.783609E+12	0.00005292	0.00146271	27.64178127	3189.40607	60000.00000
3.605100E+08	6.604763E+12	0.00005458	0.00149633	27.41359109	3217.18780	60000.00000
3.619065E+08	6.433893E+12	0.00005625	0.00152958	27.19245046	3242.72053	60000.00000
3.632898E+08	6.272629E+12	0.00005792	0.00156292	26.98574334	3266.40488	60000.00000
3.646301E+08	6.119666E+12	0.00005958	0.00159626	26.79034621	3288.14756	60000.00000
3.657706E+08	5.971764E+12	0.00006125	0.00162897	26.59535033	3307.58501	60000.00000
3.668986E+08	5.831501E+12	0.00006292	0.00166177	26.41222304	3325.22083	60000.00000
3.683458E+08	5.703419E+12	0.00006458	0.00170424	26.38820261	3345.53088	60000.00000
3.693951E+08	5.575775E+12	0.00006625	0.00173585	26.20158201	3358.37736	60000.00000
3.702605E+08	5.451689E+12	0.00006792	0.00176669	26.01267189	3369.23024	60000.00000
3.711042E+08	5.333234E+12	0.00006958	0.00179757	25.83327788	3378.45625	60000.00000
3.719375E+08	5.220176E+12	0.00007125	0.00182853	25.66355735	3386.06356	60000.00000
3.727603E+08	5.112142E+12	0.00007292	0.00185958	25.50286120	3392.03686	60000.00000
3.735690E+08	5.008747E+12	0.00007458	0.00189071	25.35032791	3396.35813	60000.00000
3.742233E+08	4.907847E+12	0.00007625	0.00192109	25.19463569	3398.96330	60000.00000
3.748678E+08	4.811137E+12	0.00007792	0.00195156	25.04676408	3399.98441	60000.00000
3.754819E+08	4.718097E+12	0.00007958	0.00198212	24.90622920	3393.47093	60000.00000
3.760877E+08	4.628772E+12	0.00008125	0.00201277	24.77259833	3385.85592	60000.00000
3.766889E+08	4.542982E+12	0.00008292	0.00204352	24.64547020	3390.28101	60000.00000
3.772852E+08	4.460514E+12	0.00008458	0.00207436	24.52446717	3394.58368	60000.00000
3.777768E+08	4.380021E+12	0.00008625	0.00210460	24.40119034	3397.57963	60000.00000
3.782499E+08	4.302369E+12	0.00008792	0.00213484	24.28250831	3399.38470	60000.00000
3.782499E+08	4.222325E+12	0.00008958	0.00216792	24.19999856	3399.35998	60000.00000
3.785457E+08	4.148446E+12	0.00009125	0.00220825	24.19999856	3390.15594	60000.00000
3.799668E+08	4.089329E+12	0.00009292	0.00224281	24.13785464	3382.47763	60000.00000
3.803819E+08	4.021659E+12	0.00009458	0.00227198	24.02094680	3386.43806	60000.00000
3.807947E+08	3.956308E+12	0.00009625	0.00230122	23.90880686	3390.65692	60000.00000
3.812051E+08	3.893158E+12	0.00009792	0.00233053	23.80120665	3394.10273	60000.00000
3.815485E+08	3.831449E+12	0.00009958	0.00235927	23.69145066	3396.69455	60000.00000
3.818629E+08	3.771485E+12	0.00010125	0.00238781	23.58331937	3398.52615	60000.00000

3.821752E+08	3.713443E+12	0.00010292	0.00241642	23.47933835	3399.63052	60000.00000
3.824854E+08	3.657231E+12	0.00010458	0.00244509	23.37932271	3399.99740	60000.00000
3.827868E+08	3.602699E+12	0.00010625	0.00247398	23.28455490	3394.78418	60000.00000
3.830870E+08	3.549841E+12	0.00010792	0.00250293	23.19314665	3389.55864	60000.00000
3.833650E+08	3.498388E+12	0.00010958	0.00253235	23.10890204	3384.20618	60000.00000
3.836295E+08	3.448355E+12	0.00011125	0.00256208	23.02995247	3378.77226	60000.00000
3.838801E+08	3.399676E+12	0.00011292	0.00259213	22.95616418	3378.93161	60000.00000
3.841291E+08	3.352399E+12	0.00011458	0.00262224	22.88501555	3383.58659	60000.00000
3.843353E+08	3.306110E+12	0.00011625	0.00265216	22.81430358	3387.62034	60000.00000
3.846572E+08	3.216645E+12	0.00011958	0.00271194	22.67823368	3393.97390	60000.00000
3.849731E+08	3.131985E+12	0.00012292	0.00277195	22.55147141	3398.08523	60000.00000
3.852586E+08	3.051553E+12	0.00012625	0.00283283	22.43823391	3399.91839	60000.00000
3.855131E+08	2.975021E+12	0.00012958	0.00289462	22.33791929	3392.87606	60000.00000
3.857602E+08	2.902271E+12	0.00013292	0.00295670	22.24478406	3383.25441	60000.00000
3.860036E+08	2.833054E+12	0.00013625	0.00301896	22.15749854	3373.58622	60000.00000
3.862154E+08	2.766917E+12	0.00013958	0.00308218	22.08129877	3372.04150	60000.00000
3.863390E+08	2.703247E+12	0.00014292	0.00314428	22.00082678	3380.81542	60000.00000
3.878648E+08	2.652067E+12	0.00014625	0.00321750	22.00000066	3390.22842	60000.00000
3.893390E+08	2.602824E+12	0.00014958	0.00329083	22.00000066	3396.50984	60000.00000
3.907463E+08	2.555289E+12	0.00015292	0.00336417	22.00000066	3399.62741	60000.00000
3.918816E+08	2.508043E+12	0.00015625	0.00343750	22.00000066	3394.51569	60000.00000
3.918816E+08	2.455655E+12	0.00015958	0.00350985	21.99381262	3384.11931	60000.00000
3.918816E+08	2.405412E+12	0.00016292	0.00357301	21.93154281	3376.14802	60000.00000
3.918816E+08	2.357183E+12	0.00016625	0.00363634	21.87275058	3368.13365	60000.00000
3.918816E+08	2.310850E+12	0.00016958	0.00369984	21.81725496	3360.07514	60000.00000
3.918816E+08	2.266304E+12	0.00017292	0.00376351	21.76489466	3361.62745	60000.00000
3.918816E+08	2.223442E+12	0.00017625	0.00382736	21.71552414	3370.17444	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 385929.47495 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number            =          1
Depth below pile head        =     60.000 in
Depth below ground surface   =     48.000 in
Equivalent Depth (see note)  =     48.000 in
Pile Diameter                =    132.000 in
Angle of Friction            =     46.000 deg.
Avg. Eff. Unit Weight        =    0.05300 pci
k                            =    225.000 pci
A (static)                   =     2.5755
B (static)                   =     1.9145
Pst                          =   2979.144 lbs/in
Psd                          =  82368.160 lbs/in
Ps                           =   2979.144 lbs/in
Cbar                         =  4587.6751
n                            =     3.6210
m                            =   715.9795
yk                           =     0.3064 in
pm                           =   5703.707 lbs/in
ym                           =     2.2000 in
pu                           =   7672.651 lbs/in
yu                           =     4.9500 in
p-multiplier                 =    1.00000
y-multiplier                 =    1.00000
```

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in
0.0000	0.0000
0.1833333	1980.0000
0.3666667	3477.4460
0.5500000	3889.4693
0.7333333	4211.0834
0.9166667	4478.7502
1.1000	4710.0313
1.2833	4914.8701
1.4667	5099.4965
1.6500	5268.0968
1.8333	5423.6329
2.0167	5568.2847
2.2000	5703.7075
3.5750	6688.1793
4.9500	7672.6512
136.9500	7672.6512
268.9500	7672.6512

```
* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.




p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number             =            3
Depth below pile head         =      174.000 in
Depth below ground surface    =      162.000 in
Equivalent Depth (see note)   =      153.014 in
Pile Diameter                 =      132.000 in
Angle of Friction             =       48.000 deg.
Avg. Eff. Unit Weight         =      0.06404 pci
k                             =      225.000 pci
A (static)                    =       1.9986
B (static)                    =       1.4540
Pst                           =    23086.289 lbs/in
Psd                           =   455827.647 lbs/in
Ps                            =    23086.289 lbs/in
Cbar                          =   26505.7668
n                             =       3.3378
m                             =    4571.3266
yk                            =       0.6884 in
pm                            =    33568.262 lbs/in
ym                            =       2.2000 in
pu                            =    46139.410 lbs/in
yu                            =       4.9500 in
p-multiplier                  =      1.00000
y-multiplier                  =      1.00000

This p-y curve is computed using the equivalent depth.

        y, in            p, lbs/in
----------------    -----------------
         0.0000          0.0000
      0.1833333       6311.8182   *
      0.3666667      12623.6363   *
      0.5500000      18935.4545   *
      0.7333333      24153.7859
      0.9166667      25823.7358
         1.1000      27273.5366
         1.2833      28562.6469
         1.4667      29728.4735
         1.6500      30796.2405
         1.8333      31783.8473
         2.0167      32704.5028
         2.2000      33568.2618
         3.5750      39853.8359
         4.9500      46139.4100
       136.9500      46139.4100
       268.9500      46139.4100

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.




------------------------------------------------------------------------------
             Computed Values of Load Distribution and Deflection
                 for Lateral Loading for Load Case Number  1
------------------------------------------------------------------------------

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head  =      221503.000 lbs
Specified moment at pile head       =   235128000.000 in-lbs
Specified axial load at pile head   =      117367.000 lbs

  Depth    Deflect.  Moment     Shear     Slope      Total   Flx. Rig. Soil Res.    Es*h
    X         y         M          V         S       Stress      EI        p         F/L
    in       in      lbs-in      lbs       Rad.  lbs/in**2 lbs-in**2  lbs/in
-------- --------- --------- --------- --------- --------- --------- --------- ---------
   0.000     1.665  2.35E+08  2.22E+05 -0.009280  1049.893  1.24E+13     0.000     0.000
```

3.360	1.633	2.36E+08	2.22E+05	-0.009216	1053.205	1.24E+13	0.000	0.000
6.720	1.603	2.37E+08	2.22E+05	-0.009152	1056.517	1.24E+13	0.000	0.000
10.080	1.572	2.37E+08	2.22E+05	-0.009088	1059.829	1.24E+13	0.000	0.000
13.440	1.542	2.38E+08	2.22E+05	-0.009024	1063.141	1.24E+13	0.000	0.000
16.800	1.511	2.39E+08	2.22E+05	-0.008959	1066.453	1.24E+13	0.000	0.000
20.160	1.481	2.40E+08	2.22E+05	-0.008894	1069.764	1.24E+13	0.000	0.000
23.520	1.452	2.40E+08	2.22E+05	-0.008829	1073.076	1.24E+13	0.000	0.000
26.880	1.422	2.41E+08	2.22E+05	-0.008764	1076.387	1.24E+13	0.000	0.000
30.240	1.393	2.42E+08	2.22E+05	-0.008698	1079.699	1.24E+13	0.000	0.000
33.600	1.364	2.43E+08	2.22E+05	-0.008632	1083.010	1.24E+13	0.000	0.000
36.960	1.335	2.43E+08	2.22E+05	-0.008566	1086.321	1.24E+13	0.000	0.000
40.320	1.306	2.44E+08	2.22E+05	-0.008500	1089.632	1.24E+13	0.000	0.000
43.680	1.278	2.45E+08	2.16E+05	-0.008434	1092.943	1.24E+13	-3004.724	7902.596
47.040	1.249	2.46E+08	2.06E+05	-0.008367	1096.103	1.24E+13	-3359.401	9035.042
50.400	1.221	2.46E+08	1.94E+05	-0.008301	1099.096	1.24E+13	-3718.213	10229.
53.760	1.194	2.47E+08	1.81E+05	-0.008234	1101.902	1.24E+13	-4080.430	11487.
57.120	1.166	2.47E+08	1.66E+05	-0.008167	1104.504	1.24E+13	-4445.325	12810.
60.480	1.139	2.48E+08	1.51E+05	-0.008099	1106.884	1.24E+13	-4812.167	14200.
63.840	1.112	2.48E+08	1.34E+05	-0.008032	1109.023	1.24E+13	-5180.225	15659.
67.200	1.085	2.49E+08	1.16E+05	-0.007965	1110.904	1.24E+13	-5548.768	17188.
70.560	1.058	2.49E+08	96821.	-0.007897	1112.506	1.24E+13	-5917.064	18791.
73.920	1.032	2.50E+08	75664.	-0.007829	1113.813	1.24E+13	-6676.355	21745.
77.280	1.005	2.50E+08	52287.	-0.007761	1114.785	1.24E+13	-7238.269	24190.
80.640	0.979450	2.50E+08	27021.	-0.007694	1115.396	1.24E+13	-7801.039	26761.
84.000	0.953713	2.50E+08	-144.256	-0.007626	1115.616	1.24E+13	-8368.930	29484.
87.360	0.928205	2.50E+08	-29229.	-0.007558	1115.418	1.24E+13	-8943.209	32373.
90.720	0.902924	2.50E+08	-60242.	-0.007490	1114.773	1.24E+13	-9516.908	35415.
94.080	0.877871	2.50E+08	-93179.	-0.007422	1113.651	1.24E+13	-10089.	38615.
97.440	0.853046	2.49E+08	-1.28E+05	-0.007355	1112.026	1.24E+13	-10658.	41980.
100.800	0.828448	2.49E+08	-1.65E+05	-0.007287	1109.867	1.24E+13	-11223.	45519.
104.160	0.804077	2.48E+08	-2.03E+05	-0.007220	1107.147	1.24E+13	-11783.	49240.
107.520	0.779932	2.47E+08	-2.44E+05	-0.007152	1103.837	1.24E+13	-12338.	53151.
110.880	0.756013	2.46E+08	-2.86E+05	-0.007085	1099.911	1.24E+13	-12884.	57263.
114.240	0.732318	2.45E+08	-3.31E+05	-0.007019	1095.340	1.24E+13	-13423.	61585.
117.600	0.708847	2.44E+08	-3.77E+05	-0.006952	1090.098	1.24E+13	-13952.	66131.
120.960	0.685599	2.43E+08	-4.24E+05	-0.006886	1084.159	1.24E+13	-14470.	70914.
124.320	0.662572	2.41E+08	-4.74E+05	-0.006821	1077.495	1.24E+13	-14976.	75947.
127.680	0.639765	2.40E+08	-5.25E+05	-0.006755	1070.083	1.24E+13	-15470.	81246.
131.040	0.617177	2.38E+08	-5.78E+05	-0.006691	1061.898	1.24E+13	-15914.	86639.
134.400	0.594805	2.36E+08	-6.30E+05	-0.006626	1052.916	1.24E+13	-15178.	85741.
137.760	0.572648	2.34E+08	-6.81E+05	-0.006563	1043.176	1.24E+13	-15046.	88281.
141.120	0.550703	2.31E+08	-7.31E+05	-0.006500	1032.683	1.24E+13	-14886.	90821.
144.480	0.528970	2.29E+08	-7.81E+05	-0.006437	1021.446	1.24E+13	-14698.	93361.
147.840	0.507444	2.26E+08	-8.30E+05	-0.006376	1009.474	1.24E+13	-14484.	95901.
151.200	0.486124	2.23E+08	-8.78E+05	-0.006315	996.777	1.24E+13	-14243.	98442.
154.560	0.465007	2.20E+08	-9.25E+05	-0.006255	983.368	1.24E+13	-13975.	1.01E+05
157.920	0.444090	2.17E+08	-9.72E+05	-0.006196	969.261	1.24E+13	-13682.	1.04E+05
161.280	0.423370	2.14E+08	-1.02E+06	-0.006138	954.469	1.24E+13	-13364.	1.06E+05
164.640	0.402845	2.10E+08	-1.06E+06	-0.006080	939.009	1.24E+13	-13021.	1.09E+05
168.000	0.382510	2.06E+08	-1.10E+06	-0.006024	922.898	1.24E+13	-12653.	1.11E+05
171.360	0.362362	2.03E+08	-1.15E+06	-0.005969	906.154	1.24E+13	-12260.	1.14E+05
174.720	0.342399	1.99E+08	-1.19E+06	-0.005915	888.797	1.24E+13	-11844.	1.16E+05
178.080	0.322616	1.95E+08	-1.23E+06	-0.005862	870.848	1.24E+13	-11403.	1.19E+05
181.440	0.303009	1.91E+08	-1.26E+06	-0.005810	852.329	1.25E+13	-10939.	1.21E+05
184.800	0.283575	1.86E+08	-1.30E+06	-0.005759	833.262	1.25E+13	-10452.	1.24E+05
188.160	0.264310	1.82E+08	-1.33E+06	-0.005709	813.673	1.25E+13	-9941.796	1.26E+05
191.520	0.245210	1.77E+08	-1.37E+06	-0.005661	793.587	1.25E+13	-9408.728	1.29E+05
194.880	0.226270	1.73E+08	-1.40E+06	-0.005614	773.030	1.25E+13	-8853.058	1.31E+05
198.240	0.207486	1.68E+08	-1.43E+06	-0.005568	752.031	1.25E+13	-8274.979	1.34E+05
201.600	0.188854	1.63E+08	-1.45E+06	-0.005523	730.617	1.25E+13	-7674.670	1.37E+05
204.960	0.170369	1.58E+08	-1.48E+06	-0.005480	708.820	1.25E+13	-7052.289	1.39E+05
208.320	0.152028	1.53E+08	-1.50E+06	-0.005438	686.670	1.25E+13	-6407.981	1.42E+05
211.680	0.133824	1.48E+08	-1.52E+06	-0.005398	664.200	1.25E+13	-5741.873	1.44E+05
215.040	0.115754	1.43E+08	-1.54E+06	-0.005359	641.443	1.25E+13	-5054.076	1.47E+05
218.400	0.097813	1.38E+08	-1.55E+06	-0.005321	618.432	1.25E+13	-4344.683	1.49E+05
221.760	0.079997	1.32E+08	-1.57E+06	-0.005285	595.205	1.25E+13	-3613.773	1.52E+05
225.120	0.062299	1.27E+08	-1.58E+06	-0.005250	571.797	1.25E+13	-2861.407	1.54E+05
228.480	0.044716	1.22E+08	-1.59E+06	-0.005230	548.245	5.94E+13	-2087.631	1.57E+05
231.840	0.027157	1.17E+08	-1.59E+06	-0.005223	524.590	5.94E+13	-1288.369	1.59E+05
235.200	0.009619	1.11E+08	-1.60E+06	-0.005216	500.870	5.95E+13	-463.624	1.62E+05
238.560	-0.007897	1.06E+08	-1.60E+06	-0.005210	477.126	5.95E+13	386.604	1.64E+05
241.920	-0.025394	1.00E+08	-1.59E+06	-0.005204	453.402	5.96E+13	1262.321	1.67E+05
245.280	-0.042871	9.51E+07	-1.59E+06	-0.005199	429.741	5.97E+13	2163.531	1.70E+05
248.640	-0.060330	8.98E+07	-1.58E+06	-0.005194	406.188	5.97E+13	3090.246	1.72E+05
252.000	-0.077773	8.45E+07	-1.57E+06	-0.005189	382.790	5.98E+13	4042.477	1.75E+05
255.360	-0.095199	7.93E+07	-1.55E+06	-0.005184	359.594	5.98E+13	5020.239	1.77E+05
258.720	-0.112611	7.41E+07	-1.53E+06	-0.005180	336.649	5.99E+13	6023.550	1.80E+05
262.080	-0.130008	6.90E+07	-1.51E+06	-0.005176	314.005	5.99E+13	7052.429	1.82E+05
265.440	-0.147393	6.39E+07	-1.49E+06	-0.005172	291.713	6.00E+13	8106.899	1.85E+05
268.800	-0.164765	5.90E+07	-1.46E+06	-0.005169	269.827	6.00E+13	9186.983	1.87E+05
272.160	-0.182126	5.42E+07	-1.42E+06	-0.005166	248.401	6.01E+13	10293.	1.90E+05

275.520	-0.199478	4.94E+07	-1.39E+06	-0.005163	227.488	6.02E+13	11424.	1.92E+05
278.880	-0.216820	4.48E+07	-1.35E+06	-0.005160	207.148	6.02E+13	12581.	1.95E+05
282.240	-0.234153	4.04E+07	-1.30E+06	-0.005158	187.436	6.02E+13	13632.	1.96E+05
285.600	-0.251479	3.61E+07	-1.25E+06	-0.005156	168.405	6.03E+13	14831.	1.98E+05
288.960	-0.268798	3.20E+07	-1.20E+06	-0.005154	150.116	6.03E+13	16055.	2.01E+05
292.320	-0.286111	2.80E+07	-1.15E+06	-0.005152	132.630	6.04E+13	17306.	2.03E+05
295.680	-0.303419	2.43E+07	-1.09E+06	-0.005151	116.010	6.04E+13	18582.	2.06E+05
299.040	-0.320723	2.07E+07	-1.02E+06	-0.005149	100.318	6.04E+13	19884.	2.08E+05
302.400	-0.338022	1.74E+07	-9.53E+05	-0.005148	85.620	6.04E+13	21212.	2.11E+05
305.760	-0.355319	1.43E+07	-8.79E+05	-0.005147	71.983	6.04E+13	22566.	2.13E+05
309.120	-0.372612	1.15E+07	-8.01E+05	-0.005147	59.475	6.04E+13	23946.	2.16E+05
312.480	-0.389904	8.94E+06	-7.18E+05	-0.005146	48.163	6.04E+13	25352.	2.18E+05
315.840	-0.407194	6.67E+06	-6.31E+05	-0.005146	38.119	6.04E+13	26784.	2.21E+05
319.200	-0.424482	4.71E+06	-5.38E+05	-0.005145	29.415	6.04E+13	28243.	2.24E+05
322.560	-0.441770	3.06E+06	-4.41E+05	-0.005145	22.122	6.04E+13	29727.	2.26E+05
325.920	-0.459057	1.75E+06	-3.38E+05	-0.005145	16.316	6.04E+13	31237.	2.29E+05
329.280	-0.476344	7.89E+05	-2.31E+05	-0.005145	12.071	6.04E+13	32773.	2.31E+05
332.640	-0.493631	2.01E+05	-1.18E+05	-0.005145	9.465	6.04E+13	34336.	2.34E+05
336.000	-0.510917	0.000	0.000	-0.005145	8.576	6.04E+13	35925.	1.18E+05

```
Please note that because this analysis makes computations of ultimate moment
capacity and pile response using nonlinear bending stiffness that the above
values of total stress due to combined axial stress and bending may not be
representative of actual conditions.


Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection             =     1.66454483 in
Computed slope at pile head      =    -0.00928012
Maximum bending moment           =   2.499683E+08 lbs-in
Maximum shear force              =       -1595564. lbs
Depth of maximum bending moment  =    84.00000000 in
Depth of maximum shear force     =      238.56000 in
Number of iterations             =             60
Number of zero deflection points =              1




-------------------------------------------------------------------------------
                          Summary of Pile Response(s)
-------------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2           lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  2.22E+05 M=  2.35E+08     117367.      1.6645  2.4997E+08   -1595564.

The analysis ended normally.
```

B.12 Drained Analysis from CPT (Ultimate)

```
===============================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

                Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

                         (c) 1985-2010 by Ensoft, Inc.
```

```
================================================================================

This program is licensed to:

Zach McClellan
University Of Utah

--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using CPT Friction Angles.lpd
Name of output file:         Drilled Shaft Analysis Using CPT Friction Angles.lpo
Name of plot output file:    Drilled Shaft Analysis Using CPT Friction Angles.lpp
Name of runtime file:        Drilled Shaft Analysis Using CPT Friction Angles.lpr


--------------------------------------------------------------------------------
                         Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:  10:50:00


--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

Drilled Shaft Analysis Using  CPT based Friction Angles


--------------------------------------------------------------------------------
                              Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments            =         100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


--------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                               =     336.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface             =       0.00 deg.

Structural properties of pile defined using  2 points
```

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	132.00000	14902723.	13685.0000	3604997.
2	336.0000	132.00000	14902723.	13685.0000	3604997.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of moment of inertia and modulus of are not used for any computations other than total stress due to combined axial loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

```
Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       12.000 in
Distance from top of pile to bottom of layer =       72.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3
```

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

```
Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       72.000 in
Distance from top of pile to bottom of layer =      132.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3
```

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

```
Layer  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      132.000 in
Distance from top of pile to bottom of layer =      282.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3
```

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

```
Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3
```

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

```
Layer  5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      492.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3
```

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

(Depth of lowest layer extends 156.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 10 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300

4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.06900
10	492.00	0.06900

Shear Strength of Soils

Shear strength parameters with depth defined using 10 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	0.00000	48.00	------	------
4	132.000	0.00000	48.00	------	------
5	132.000	0.00000	48.00	------	------
6	282.000	0.00000	48.00	------	------
7	282.000	0.00000	48.00	------	------
8	396.000	0.00000	48.00	------	------
9	396.000	0.00000	48.00	------	------
10	492.000	0.00000	48.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	0.0000	1.0000
3	42.000	1.0000	1.0000
4	1200.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 319693.000 lbs
Bending moment at pile head = 345051000.000 in-lbs
Axial load at pile head = 189766.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

```
--------------------------------------------------------------------------------
                  Output of p-y Curves at Specified Depths
--------------------------------------------------------------------------------


p-y curves are generated and printed for verification at  2 depths.

Depth      Depth Below Pile Head      Depth Below Ground Surface
 No.                 in                          in
-----      ---------------------      --------------------------
  1               60.000                      48.000
  2              174.000                     162.000

Depth of ground surface below top of pile =      12.00 in



--------------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

Number of sections =  1



Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                       =     132.0000 in

Material Properties:

Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =           90
Area of Single Bar                     =      1.27000 in**2
Number of Rows of Reinforcing Bars     =           45
Area of Steel                          =      114.300 in**2
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        0.835 percent
Cover Thickness (edge to bar center)   =        4.000 in

Unfactored Axial Squash Load Capacity  =     52997.63 kip

Distribution and Area of Steel Reinforcement

 Row         Area of        Distance to
Number     Reinforcement   Centroidal Axis
               in**2             in
------     -------------   ---------------
   1           2.540            61.962
   2           2.540            61.660
   3           2.540            61.058
   4           2.540            60.158
   5           2.540            58.966
   6           2.540            57.485
   7           2.540            55.725
   8           2.540            53.694
   9           2.540            51.400
  10           2.540            48.857
  11           2.540            46.075
  12           2.540            43.069
  13           2.540            39.853
  14           2.540            36.443
  15           2.540            32.855
  16           2.540            29.107
  17           2.540            25.218
  18           2.540            21.205
  19           2.540            17.090
  20           2.540            12.891
  21           2.540             8.629
  22           2.540             4.325
  23           2.540             0.000
  24           2.540            -4.325
  25           2.540            -8.629
```

26	2.540	-12.891
27	2.540	-17.090
28	2.540	-21.205
29	2.540	-25.218
30	2.540	-29.107
31	2.540	-32.855
32	2.540	-36.443
33	2.540	-39.853
34	2.540	-43.069
35	2.540	-46.075
36	2.540	-48.857
37	2.540	-51.400
38	2.540	-53.694
39	2.540	-55.725
40	2.540	-57.485
41	2.540	-58.966
42	2.540	-60.158
43	2.540	-61.058
44	2.540	-61.660
45	2.540	-61.962

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25181408.	6.043538E+13	4.166667E-07	0.00002759	66.21742111	97.95383531	751.33747
50136430.	6.016372E+13	8.333333E-07	0.00005518	66.21697265	194.47463	1502.66409
74865067.	5.989205E+13	0.00000125	0.00008277	66.21652025	289.56242	2253.97974
99367320.	5.962039E+13	0.00000167	0.00011036	66.21605998	383.21724	3005.28408
1.236432E+08	5.934873E+13	0.00000208	0.00013795	66.21559578	475.43913	3756.57705
1.236432E+08	4.945727E+13	0.00000250	0.00007949	31.79650587	273.35193	6972.01509
1.236432E+08	4.239195E+13	0.00000292	0.00009280	31.81586856	317.99257	8132.37985
1.236432E+08	3.709296E+13	0.00000333	0.00010612	31.83531779	362.36870	9292.26830
1.236432E+08	3.297152E+13	0.00000375	0.00011946	31.85484964	406.47939	10451.67775
1.236432E+08	2.967436E+13	0.00000417	0.00013281	31.87446803	450.32382	11610.60473
1.236432E+08	2.697670E+13	0.00000458	0.00014618	31.89417690	493.90115	12769.04556
1.236432E+08	2.472864E+13	0.00000500	0.00015957	31.91396838	537.21037	13926.99812
1.236432E+08	2.282643E+13	0.00000542	0.00017298	31.93385428	580.25077	15084.45755
1.236432E+08	2.119597E+13	0.00000583	0.00018640	31.95382673	623.02128	16241.42177
1.236432E+08	1.978291E+13	0.00000625	0.00019984	31.97388965	665.52107	17397.88692
1.236432E+08	1.854648E+13	0.00000667	0.00021329	31.99404305	707.74918	18553.84972
1.236432E+08	1.745551E+13	0.00000708	0.00022677	32.01428694	749.70467	19709.30690
1.236432E+08	1.648576E+13	0.00000750	0.00024026	32.03462523	791.38666	20864.25431
1.236432E+08	1.561809E+13	0.00000792	0.00025377	32.05505794	832.79420	22018.68854
1.236432E+08	1.483718E+13	0.00000833	0.00026730	32.07558507	873.92631	23172.60617
1.236432E+08	1.413065E+13	0.00000875	0.00028084	32.09620661	914.78199	24326.00376
1.236432E+08	1.348835E+13	0.00000917	0.00029441	32.11692256	955.36025	25478.87790
1.236432E+08	1.290190E+13	0.00000958	0.00030799	32.13773686	995.66017	26631.22407
1.253513E+08	1.253513E+13	0.00001000	0.00032159	32.15864950	1035.68073	27783.03871
1.305096E+08	1.252892E+13	0.00001042	0.00033520	32.17966443	1075.42102	28934.31707
1.356625E+08	1.252269E+13	0.00001083	0.00034884	32.20077378	1114.87976	30085.05790
1.408098E+08	1.251643E+13	0.00001125	0.00036250	32.22198540	1154.05612	31235.25522
1.459517E+08	1.251015E+13	0.00001167	0.00037617	32.24330324	1192.94917	32384.90399
1.510881E+08	1.250384E+13	0.00001208	0.00038987	32.26471943	1231.55756	33534.00311
1.562189E+08	1.249751E+13	0.00001250	0.00040358	32.28624183	1269.88047	34682.54617
1.613441E+08	1.249116E+13	0.00001292	0.00041731	32.30786651	1307.91664	35830.53080
1.664637E+08	1.248477E+13	0.00001333	0.00043106	32.32959741	1345.66510	36977.95176
1.715776E+08	1.247837E+13	0.00001375	0.00044483	32.35143453	1383.12470	38124.80520
1.766858E+08	1.247194E+13	0.00001417	0.00045862	32.37338179	1420.29446	39271.08566
1.817883E+08	1.246548E+13	0.00001458	0.00047243	32.39543921	1457.17321	40416.78915
1.868850E+08	1.245900E+13	0.00001500	0.00048626	32.41760284	1493.75962	41561.91337
1.919759E+08	1.245249E+13	0.00001542	0.00050011	32.43988055	1530.05281	42706.45097
1.970610E+08	1.244596E+13	0.00001583	0.00051399	32.46227235	1566.05158	43850.39781
2.021402E+08	1.243940E+13	0.00001625	0.00052788	32.48477429	1601.75456	44993.75160
2.122808E+08	1.242619E+13	0.00001708	0.00055572	32.53012437	1672.26881	47278.65630
2.223975E+08	1.241288E+13	0.00001792	0.00058365	32.57594651	1741.58621	49561.12379
2.324898E+08	1.239946E+13	0.00001875	0.00061167	32.62224466	1809.69661	51841.11772
2.425576E+08	1.238592E+13	0.00001958	0.00063977	32.66903061	1876.59000	54118.59688
2.526004E+08	1.237227E+13	0.00002042	0.00066796	32.71631223	1942.25590	56393.52123
2.626180E+08	1.235850E+13	0.00002125	0.00069624	32.76410919	2006.68416	58665.84273
2.721121E+08	1.232206E+13	0.00002208	0.00072411	32.78967565	2068.72058	60000.00000
2.795383E+08	1.219804E+13	0.00002292	0.00074996	32.72565132	2124.87068	60000.00000
2.858830E+08	1.203718E+13	0.00002375	0.00077475	32.62121004	2177.48620	60000.00000
2.913909E+08	1.185319E+13	0.00002458	0.00079869	32.48905045	2227.16671	60000.00000
2.963306E+08	1.165891E+13	0.00002542	0.00082203	32.34232360	2274.58154	60000.00000
3.007969E+08	1.145893E+13	0.00002625	0.00084487	32.18566364	2319.98265	60000.00000
3.048770E+08	1.125700E+13	0.00002708	0.00086729	32.02311462	2363.60474	60000.00000
3.086357E+08	1.105561E+13	0.00002792	0.00088936	31.85755616	2405.62971	60000.00000

3.120117E+08	1.085258E+13	0.00002875	0.00091096	31.68568772	2445.90409	60000.00000
3.151933E+08	1.065442E+13	0.00002958	0.00093235	31.51608127	2484.93178	60000.00000
3.181679E+08	1.046031E+13	0.00003042	0.00095350	31.34785169	2522.69974	60000.00000
3.208838E+08	1.026828E+13	0.00003125	0.00097431	31.17791480	2559.06830	60000.00000
3.235065E+08	1.008332E+13	0.00003208	0.00099503	31.01396137	2594.50546	60000.00000
3.258804E+08	9.900165E+12	0.00003292	0.00101541	30.84788758	2628.58566	60000.00000
3.283735E+08	9.729584E+12	0.00003375	0.00103936	30.79570431	2667.96070	60000.00000
3.305070E+08	9.556830E+12	0.00003458	0.00105898	30.62122375	2699.19589	60000.00000
3.324844E+08	9.387796E+12	0.00003542	0.00107837	30.44806498	2729.35608	60000.00000
3.344561E+08	9.226374E+12	0.00003625	0.00109779	30.28375357	2758.90365	60000.00000
3.361933E+08	9.065887E+12	0.00003708	0.00111678	30.11552793	2787.13879	60000.00000
3.378986E+08	8.911611E+12	0.00003792	0.00113576	29.95411187	2814.70462	60000.00000
3.395986E+08	8.763835E+12	0.00003875	0.00115477	29.80043381	2841.68159	60000.00000
3.410842E+08	8.616863E+12	0.00003958	0.00117336	29.64275891	2867.42591	60000.00000
3.425468E+08	8.475384E+12	0.00004042	0.00119194	29.49135464	2892.54946	60000.00000
3.440045E+08	8.339502E+12	0.00004125	0.00121055	29.34677964	2917.10627	60000.00000
3.453646E+08	8.206683E+12	0.00004208	0.00122898	29.20355004	2940.80774	60000.00000
3.466128E+08	8.076414E+12	0.00004292	0.00124719	29.06078070	2963.62760	60000.00000
3.478564E+08	7.951003E+12	0.00004375	0.00126543	28.92408925	2985.90138	60000.00000
3.490955E+08	7.830178E+12	0.00004458	0.00128369	28.79314131	3007.62660	60000.00000
3.502570E+08	7.712081E+12	0.00004542	0.00130180	28.66357809	3028.57976	60000.00000
3.506722E+08	7.582101E+12	0.00004625	0.00132275	28.59999830	3052.26388	60000.00000
3.526325E+08	7.489539E+12	0.00004708	0.00134318	28.52766949	3074.58539	60000.00000
3.536482E+08	7.380485E+12	0.00004792	0.00136049	28.39274830	3092.76550	60000.00000
3.546602E+08	7.275081E+12	0.00004875	0.00137782	28.26298445	3110.45125	60000.00000
3.555833E+08	7.171429E+12	0.00004958	0.00139492	28.13280362	3127.36882	60000.00000
3.572817E+08	6.971350E+12	0.00005125	0.00142876	27.87832314	3159.33829	60000.00000
3.589660E+08	6.783609E+12	0.00005292	0.00146271	27.64178127	3189.40607	60000.00000
3.605100E+08	6.604763E+12	0.00005458	0.00149633	27.41359109	3217.18780	60000.00000
3.619065E+08	6.433893E+12	0.00005625	0.00152958	27.19245046	3242.72053	60000.00000
3.632898E+08	6.272629E+12	0.00005792	0.00156292	26.98574334	3266.40488	60000.00000
3.646301E+08	6.119666E+12	0.00005958	0.00159626	26.79034621	3288.14756	60000.00000
3.657706E+08	5.971764E+12	0.00006125	0.00162897	26.59535033	3307.58501	60000.00000
3.668986E+08	5.831501E+12	0.00006292	0.00166177	26.41222304	3325.22083	60000.00000
3.683458E+08	5.703419E+12	0.00006458	0.00170424	26.38820261	3345.53088	60000.00000
3.693951E+08	5.575775E+12	0.00006625	0.00173585	26.20158201	3358.37736	60000.00000
3.702605E+08	5.451689E+12	0.00006792	0.00176669	26.01267189	3369.23024	60000.00000
3.711042E+08	5.333234E+12	0.00006958	0.00179757	25.83327788	3378.45625	60000.00000
3.719375E+08	5.220176E+12	0.00007125	0.00182853	25.66355735	3386.06356	60000.00000
3.727603E+08	5.112142E+12	0.00007292	0.00185958	25.50286120	3392.03686	60000.00000
3.735690E+08	5.008747E+12	0.00007458	0.00189071	25.35032791	3396.35813	60000.00000
3.742233E+08	4.907847E+12	0.00007625	0.00192109	25.19463569	3398.96330	60000.00000
3.748678E+08	4.811137E+12	0.00007792	0.00195156	25.04676408	3399.98441	60000.00000
3.754819E+08	4.718097E+12	0.00007958	0.00198212	24.90622920	3393.47093	60000.00000
3.760877E+08	4.628772E+12	0.00008125	0.00201277	24.77259833	3385.85592	60000.00000
3.766889E+08	4.542982E+12	0.00008292	0.00204352	24.64547020	3390.28101	60000.00000
3.772852E+08	4.460514E+12	0.00008458	0.00207436	24.52446717	3394.58368	60000.00000
3.777768E+08	4.380021E+12	0.00008625	0.00210460	24.40119034	3397.57963	60000.00000
3.782499E+08	4.302369E+12	0.00008792	0.00213484	24.28250831	3399.38470	60000.00000
3.782499E+08	4.222325E+12	0.00008958	0.00216792	24.19999856	3399.35998	60000.00000
3.785457E+08	4.148446E+12	0.00009125	0.00220825	24.19999856	3390.15594	60000.00000
3.799668E+08	4.089329E+12	0.00009292	0.00224281	24.13785464	3382.47763	60000.00000
3.803819E+08	4.021659E+12	0.00009458	0.00227198	24.02094680	3386.43806	60000.00000
3.807947E+08	3.956308E+12	0.00009625	0.00230122	23.90880686	3390.65692	60000.00000
3.812051E+08	3.893158E+12	0.00009792	0.00233053	23.80120665	3394.10273	60000.00000
3.815485E+08	3.831449E+12	0.00009958	0.00235927	23.69145066	3396.69455	60000.00000
3.818629E+08	3.771485E+12	0.00010125	0.00238781	23.58331937	3398.52615	60000.00000
3.821752E+08	3.713443E+12	0.00010292	0.00241642	23.47933835	3399.63052	60000.00000
3.824854E+08	3.657231E+12	0.00010458	0.00244509	23.37932271	3399.99740	60000.00000
3.827868E+08	3.602699E+12	0.00010625	0.00247398	23.28455490	3394.78418	60000.00000
3.830870E+08	3.549841E+12	0.00010792	0.00250293	23.19314665	3389.55864	60000.00000
3.833650E+08	3.498388E+12	0.00010958	0.00253235	23.10890204	3384.20618	60000.00000
3.836295E+08	3.448355E+12	0.00011125	0.00256208	23.02995247	3378.77226	60000.00000
3.838801E+08	3.399676E+12	0.00011292	0.00259213	22.95616418	3378.93161	60000.00000
3.841291E+08	3.352399E+12	0.00011458	0.00262224	22.88501555	3383.58659	60000.00000
3.843353E+08	3.306110E+12	0.00011625	0.00265216	22.81430358	3387.62034	60000.00000
3.846572E+08	3.216645E+12	0.00011958	0.00271194	22.67823368	3393.97390	60000.00000
3.849731E+08	3.131985E+12	0.00012292	0.00277195	22.55147141	3398.08523	60000.00000
3.852586E+08	3.051553E+12	0.00012625	0.00283283	22.43823391	3399.91839	60000.00000
3.855131E+08	2.975021E+12	0.00012958	0.00289462	22.33791929	3392.87606	60000.00000
3.857602E+08	2.902271E+12	0.00013292	0.00295670	22.24478406	3383.25441	60000.00000
3.860036E+08	2.833054E+12	0.00013625	0.00301896	22.15749854	3373.58622	60000.00000
3.862154E+08	2.766917E+12	0.00013958	0.00308218	22.08129877	3372.04150	60000.00000
3.863390E+08	2.703247E+12	0.00014292	0.00314428	22.00082678	3380.81542	60000.00000
3.878648E+08	2.652067E+12	0.00014625	0.00321750	22.00000066	3390.22842	60000.00000
3.893390E+08	2.602824E+12	0.00014958	0.00329083	22.00000066	3396.50984	60000.00000
3.907463E+08	2.555289E+12	0.00015292	0.00336417	22.00000066	3399.62741	60000.00000
3.918816E+08	2.508043E+12	0.00015625	0.00343750	22.00000066	3394.51569	60000.00000
3.918816E+08	2.455655E+12	0.00015958	0.00350985	21.99381262	3384.11931	60000.00000
3.918816E+08	2.405412E+12	0.00016292	0.00357301	21.93154281	3376.14802	60000.00000
3.918816E+08	2.357183E+12	0.00016625	0.00363634	21.87275058	3368.13365	60000.00000

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  3.918816E+08  2.310850E+12    0.00016958    0.00369984   21.81725496    3360.07514   60000.00000
  3.918816E+08  2.266304E+12    0.00017292    0.00376351   21.76489466    3361.62745   60000.00000
  3.918816E+08  2.223442E+12    0.00017625    0.00382736   21.71552414    3370.17444   60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 =  385929.47495 in-kip



p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number            =           1
Depth below pile head        =      60.000 in
Depth below ground surface   =      48.000 in
Equivalent Depth (see note) =      48.000 in
Pile Diameter                =     132.000 in
Angle of Friction            =      46.000 deg.
Avg. Eff. Unit Weight        =     0.05300 pci
k                            =     225.000 pci
A (static)                   =      2.5755
B (static)                   =      1.9145
Pst                          =    2979.144 lbs/in
Psd                          =   82368.160 lbs/in
Ps                           =    2979.144 lbs/in
Cbar                         =   4587.6751
n                            =      3.6210
m                            =    715.9795
yk                           =      0.3064 in
pm                           =    5703.707 lbs/in
ym                           =      2.2000 in
pu                           =    7672.651 lbs/in
yu                           =      4.9500 in
p-multiplier                 =     1.00000
y-multiplier                 =     1.00000

This p-y curve is computed using the equivalent depth.

        y, in            p, lbs/in
----------------    -----------------
          0.0000           0.0000
       0.1833333        1980.0000   *
       0.3666667        3477.4460
       0.5500000        3889.4693
       0.7333333        4211.0834
       0.9166667        4478.7502
          1.1000        4710.0313
          1.2833        4914.8701
          1.4667        5099.4965
          1.6500        5268.0968
          1.8333        5423.6329
          2.0167        5568.2847
          2.2000        5703.7075
          3.5750        6688.1793
          4.9500        7672.6512
        136.9500        7672.6512
        268.9500        7672.6512

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.



p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number            =           3
Depth below pile head        =     174.000 in
Depth below ground surface   =     162.000 in
Equivalent Depth (see note) =     153.014 in
Pile Diameter                =     132.000 in
Angle of Friction            =      48.000 deg.
Avg. Eff. Unit Weight        =     0.06404 pci
k                            =     225.000 pci
A (static)                   =      1.9986
B (static)                   =      1.4540
Pst                          =   23086.289 lbs/in
Psd                          =  455827.647 lbs/in
Ps                           =   23086.289 lbs/in
```

```
Cbar                         =   26505.7668
n                            =       3.3378
m                            =    4571.3266
yk                           =       0.6884 in
pm                           =    33568.262 lbs/in
ym                           =       2.2000 in
pu                           =    46139.410 lbs/in
yu                           =       4.9500 in
p-multiplier                 =      1.00000
y-multiplier                 =      1.00000
```

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in	
0.0000	0.0000	
0.1833333	6311.8182	*
0.3666667	12623.6363	*
0.5500000	18935.4545	*
0.7333333	24153.7859	
0.9166667	25823.7358	
1.1000	27273.5366	
1.2833	28562.6469	
1.4667	29728.4735	
1.6500	30796.2405	
1.8333	31783.8473	
2.0167	32704.5028	
2.2000	33568.2618	
3.5750	39853.8359	
4.9500	46139.4100	
136.9500	46139.4100	
268.9500	46139.4100	

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

```
Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head  =      319693.000 lbs
Specified moment at pile head       =   345051000.000 in-lbs
Specified axial load at pile head   =      189766.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	3.350	3.45E+08	3.20E+05	-0.019805	1542.001	8.13E+12	0.000	0.000
3.360	3.284	3.46E+08	3.20E+05	-0.019662	1546.814	8.13E+12	0.000	0.000
6.720	3.218	3.47E+08	3.20E+05	-0.019518	1551.627	8.13E+12	0.000	0.000
10.080	3.153	3.48E+08	3.20E+05	-0.019373	1556.439	7.91E+12	0.000	0.000
13.440	3.088	3.49E+08	3.20E+05	-0.019223	1561.250	7.80E+12	0.000	0.000
16.800	3.024	3.50E+08	3.20E+05	-0.019071	1566.062	7.65E+12	0.000	0.000
20.160	2.960	3.52E+08	3.20E+05	-0.018916	1570.873	7.54E+12	0.000	0.000
23.520	2.896	3.53E+08	3.20E+05	-0.018758	1575.683	7.49E+12	0.000	0.000
26.880	2.834	3.54E+08	3.20E+05	-0.018598	1580.493	7.37E+12	0.000	0.000
30.240	2.772	3.55E+08	3.20E+05	-0.018436	1585.302	7.26E+12	0.000	0.000
33.600	2.710	3.56E+08	3.20E+05	-0.018270	1590.111	7.13E+12	0.000	0.000
36.960	2.649	3.57E+08	3.20E+05	-0.018100	1594.920	7.00E+12	0.000	0.000
40.320	2.588	3.58E+08	3.20E+05	-0.017927	1599.728	6.88E+12	0.000	0.000
43.680	2.528	3.59E+08	3.14E+05	-0.017750	1604.536	6.76E+12	-3618.613	4809.043
47.040	2.469	3.60E+08	3.01E+05	-0.017570	1609.162	6.64E+12	-4045.418	5505.476
50.400	2.410	3.61E+08	2.86E+05	-0.017386	1613.585	6.52E+12	-4477.667	6242.216
53.760	2.352	3.62E+08	2.71E+05	-0.017198	1617.784	6.40E+12	-4914.670	7020.681
57.120	2.295	3.63E+08	2.53E+05	-0.017006	1621.737	6.30E+12	-5355.753	7842.373
60.480	2.238	3.64E+08	2.35E+05	-0.016810	1625.421	6.20E+12	-5800.255	8708.881
63.840	2.182	3.65E+08	2.14E+05	-0.016612	1628.815	6.12E+12	-6247.488	9621.820
67.200	2.126	3.65E+08	1.93E+05	-0.016410	1631.896	6.03E+12	-6696.173	10582.
70.560	2.071	3.66E+08	1.69E+05	-0.016205	1634.641	5.95E+12	-7145.311	11590.
73.920	2.017	3.67E+08	1.44E+05	-0.015996	1637.029	5.88E+12	-8056.954	13420.
77.280	1.964	3.67E+08	1.16E+05	-0.015786	1639.013	5.83E+12	-8741.167	14955.
80.640	1.911	3.67E+08	85120.	-0.015574	1640.560	5.80E+12	-9427.709	16574.

84.000	1.859	3.68E+08	52283.	-0.015360	1641.634	5.77E+12	-10119.	18286.
87.360	1.808	3.68E+08	17116.	-0.015146	1642.203	5.76E+12	-10814.	20097.
90.720	1.757	3.68E+08	-20388.	-0.014932	1642.229	5.76E+12	-11509.	22004.
94.080	1.708	3.68E+08	-60225.	-0.014718	1641.680	5.77E+12	-12203.	24012.
97.440	1.659	3.67E+08	-1.02E+05	-0.014504	1640.520	5.80E+12	-12895.	26123.
100.800	1.610	3.67E+08	-1.47E+05	-0.014292	1638.715	5.83E+12	-13582.	28342.
104.160	1.563	3.66E+08	-1.94E+05	-0.014082	1636.230	5.90E+12	-14265.	30675.
107.520	1.516	3.66E+08	-2.43E+05	-0.013875	1633.031	5.99E+12	-14941.	33125.
110.880	1.469	3.65E+08	-2.94E+05	-0.013673	1629.085	6.11E+12	-15610.	35697.
114.240	1.424	3.64E+08	-3.48E+05	-0.013474	1624.357	6.23E+12	-16270.	38399.
117.600	1.379	3.62E+08	-4.03E+05	-0.013281	1618.816	6.38E+12	-16920.	41236.
120.960	1.334	3.61E+08	-4.61E+05	-0.013093	1612.428	6.55E+12	-17560.	44214.
124.320	1.291	3.59E+08	-5.21E+05	-0.012911	1605.161	6.74E+12	-18186.	47342.
127.680	1.248	3.57E+08	-5.83E+05	-0.012735	1596.985	6.95E+12	-18800.	50628.
131.040	1.205	3.55E+08	-6.48E+05	-0.012565	1587.868	7.19E+12	-19398.	54082.
134.400	1.163	3.53E+08	-7.12E+05	-0.012402	1577.781	7.44E+12	-19001.	54884.
137.760	1.122	3.51E+08	-7.77E+05	-0.012245	1566.743	7.60E+12	-19521.	58467.
141.120	1.081	3.48E+08	-8.43E+05	-0.012094	1554.730	7.94E+12	-20023.	62241.
144.480	1.041	3.45E+08	-9.11E+05	-0.011950	1541.714	8.24E+12	-20507.	66220.
147.840	1.001	3.42E+08	-9.81E+05	-0.011813	1527.673	8.55E+12	-20971.	70419.
151.200	0.961166	3.38E+08	-1.05E+06	-0.011681	1512.583	8.87E+12	-21413.	74856.
154.560	0.922132	3.35E+08	-1.12E+06	-0.011556	1496.421	9.20E+12	-21841.	79583.
157.920	0.883509	3.31E+08	-1.20E+06	-0.011437	1479.168	9.53E+12	-22255.	84635.
161.280	0.845278	3.27E+08	-1.27E+06	-0.011322	1460.801	9.84E+12	-22643.	90008.
164.640	0.807422	3.22E+08	-1.35E+06	-0.011213	1441.302	1.02E+13	-23006.	95736.
168.000	0.769924	3.18E+08	-1.43E+06	-0.011109	1420.653	1.05E+13	-23339.	1.02E+05
171.360	0.732768	3.13E+08	-1.51E+06	-0.011010	1398.836	1.08E+13	-23643.	1.08E+05
174.720	0.695938	3.08E+08	-1.59E+06	-0.010915	1375.837	1.11E+13	-23913.	1.15E+05
178.080	0.659421	3.02E+08	-1.67E+06	-0.010824	1351.642	1.14E+13	-23308.	1.19E+05
181.440	0.623203	2.96E+08	-1.74E+06	-0.010736	1326.281	1.17E+13	-22499.	1.21E+05
184.800	0.587272	2.90E+08	-1.82E+06	-0.010653	1299.795	1.19E+13	-21646.	1.24E+05
188.160	0.551617	2.84E+08	-1.89E+06	-0.010572	1272.227	1.21E+13	-20749.	1.26E+05
191.520	0.516228	2.78E+08	-1.96E+06	-0.010494	1243.621	1.22E+13	-19808.	1.29E+05
194.880	0.481094	2.71E+08	-2.02E+06	-0.010419	1214.025	1.23E+13	-18823.	1.31E+05
198.240	0.446209	2.64E+08	-2.08E+06	-0.010347	1183.487	1.24E+13	-17796.	1.34E+05
201.600	0.411566	2.57E+08	-2.14E+06	-0.010276	1152.059	1.24E+13	-16725.	1.37E+05
204.960	0.377156	2.50E+08	-2.20E+06	-0.010207	1119.795	1.24E+13	-15612.	1.39E+05
208.320	0.342975	2.42E+08	-2.25E+06	-0.010140	1086.750	1.24E+13	-14456.	1.42E+05
211.680	0.309015	2.35E+08	-2.29E+06	-0.010075	1052.982	1.24E+13	-13259.	1.44E+05
215.040	0.275268	2.27E+08	-2.34E+06	-0.010013	1018.551	1.24E+13	-12019.	1.47E+05
218.400	0.241728	2.19E+08	-2.37E+06	-0.009953	983.519	1.24E+13	-10737.	1.49E+05
221.760	0.208386	2.11E+08	-2.41E+06	-0.009894	947.949	1.24E+13	-9413.665	1.52E+05
225.120	0.175237	2.03E+08	-2.44E+06	-0.009839	911.909	1.24E+13	-8048.637	1.54E+05
228.480	0.142271	1.95E+08	-2.46E+06	-0.009785	875.467	1.24E+13	-6642.078	1.57E+05
231.840	0.109482	1.86E+08	-2.48E+06	-0.009734	838.692	1.25E+13	-5194.046	1.59E+05
235.200	0.076861	1.78E+08	-2.50E+06	-0.009685	801.657	1.25E+13	-3704.570	1.62E+05
238.560	0.044402	1.69E+08	-2.51E+06	-0.009638	764.437	1.25E+13	-2173.655	1.64E+05
241.920	0.012096	1.61E+08	-2.51E+06	-0.009593	727.109	1.25E+13	-601.283	1.67E+05
245.280	-0.020065	1.53E+08	-2.51E+06	-0.009551	689.750	1.25E+13	1012.591	1.70E+05
248.640	-0.052088	1.44E+08	-2.50E+06	-0.009511	652.441	1.25E+13	2668.033	1.72E+05
252.000	-0.083980	1.36E+08	-2.49E+06	-0.009474	615.266	1.25E+13	4365.131	1.75E+05
255.360	-0.115750	1.27E+08	-2.48E+06	-0.009438	578.309	1.25E+13	6103.994	1.77E+05
258.720	-0.147406	1.19E+08	-2.45E+06	-0.009418	541.657	5.94E+13	7884.753	1.80E+05
262.080	-0.179039	1.11E+08	-2.42E+06	-0.009411	505.399	5.95E+13	9712.146	1.82E+05
265.440	-0.210650	1.03E+08	-2.39E+06	-0.009405	469.627	5.96E+13	11586.	1.85E+05
268.800	-0.242242	9.50E+07	-2.34E+06	-0.009400	434.434	5.97E+13	13507.	1.87E+05
272.160	-0.273817	8.72E+07	-2.30E+06	-0.009395	399.916	5.97E+13	15475.	1.90E+05
275.520	-0.305374	7.96E+07	-2.24E+06	-0.009390	366.172	5.98E+13	17489.	1.92E+05
278.880	-0.336917	7.21E+07	-2.18E+06	-0.009386	333.303	5.99E+13	19550.	1.95E+05
282.240	-0.368446	6.49E+07	-2.11E+06	-0.009382	301.411	6.00E+13	21450.	1.96E+05
285.600	-0.399963	5.80E+07	-2.03E+06	-0.009378	270.591	6.01E+13	23588.	1.98E+05
288.960	-0.431469	5.13E+07	-1.95E+06	-0.009375	240.951	6.01E+13	25772.	2.01E+05
292.320	-0.462966	4.49E+07	-1.86E+06	-0.009373	212.599	6.02E+13	28003.	2.03E+05
295.680	-0.494454	3.88E+07	-1.76E+06	-0.009370	185.648	6.02E+13	30281.	2.06E+05
299.040	-0.525934	3.30E+07	-1.66E+06	-0.009368	160.210	6.03E+13	32607.	2.08E+05
302.400	-0.557409	2.77E+07	-1.54E+06	-0.009367	136.403	6.04E+13	34980.	2.11E+05
305.760	-0.588878	2.27E+07	-1.42E+06	-0.009365	114.345	6.04E+13	37400.	2.13E+05
309.120	-0.620343	1.81E+07	-1.29E+06	-0.009364	94.156	6.04E+13	39867.	2.16E+05
312.480	-0.651805	1.40E+07	-1.15E+06	-0.009363	75.961	6.04E+13	42382.	2.18E+05
315.840	-0.683264	1.04E+07	-1.01E+06	-0.009363	59.885	6.04E+13	44944.	2.21E+05
319.200	-0.714721	7.27E+06	-8.51E+05	-0.009362	46.056	6.04E+13	47553.	2.24E+05
322.560	-0.746177	4.68E+06	-6.89E+05	-0.009362	34.604	6.04E+13	48997.	2.21E+05
325.920	-0.777632	2.65E+06	-5.22E+05	-0.009362	25.603	6.04E+13	50145.	2.17E+05
329.280	-0.809087	1.18E+06	-3.52E+05	-0.009361	19.108	6.04E+13	51278.	2.13E+05
332.640	-0.840541	2.96E+05	-1.78E+05	-0.009361	15.178	6.04E+13	52395.	2.09E+05
336.000	-0.871995	0.000	0.000	-0.009361	13.867	6.04E+13	53498.	1.03E+05

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

```
Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection            =     3.35025035 in
Computed slope at pile head     =    -0.01980463
Maximum bending moment          =   3.676824E+08 lbs-in
Maximum shear force             =      -2511408. lbs
Depth of maximum bending moment  =    90.72000000 in
Depth of maximum shear force    =      241.92000 in
Number of iterations            =             64
Number of zero deflection points =             1



-------------------------------------------------------------------------------
                          Summary of Pile Response(s)
-------------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2           lbs         in         in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  3.20E+05 M=  3.45E+08     189766.      3.3503  3.6768E+08   -2511408.

The analysis ended normally.
```

B.13 Undrained Analysis from CPT (Service)

```
===============================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method

                       (c) 1985-2010 by Ensoft, Inc.
                            All Rights Reserved

===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                            Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using CPT Undrained Shear Strengths.lpd
Name of output file:         Drilled Shaft Analysis Using CPT Undrained Shear Strengths.lpo
Name of plot output file:    Drilled Shaft Analysis Using CPT Undrained Shear Strengths.lpp
Name of runtime file:        Drilled Shaft Analysis Using CPT Undrained Shear Strengths.lpr

-------------------------------------------------------------------------------
                          Time and Date of Analysis
-------------------------------------------------------------------------------
```

Date: October 11, 2012 Time: 10:20:55

Problem Title

Drilled Shaft Analysis Using Undrained Parameters from CPT

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 384.00 in

Depth of ground surface below top of pile = 12.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	132.00000	14902723.	13685.0000	3604997.
2	384.0000	132.00000	14902723.	13685.0000	3604997.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of moment of inertia and modulus of are not used for any computations other than total stress due to combined axial loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 12.000 in
Distance from top of pile to bottom of layer = 72.000 in

```
p-y subgrade modulus k for top of soil layer =       0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =       0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is stiff clay without free water
Distance from top of pile to top of layer    =      72.000 in
Distance from top of pile to bottom of layer =     132.000 in

Layer  3 is stiff clay without free water
Distance from top of pile to top of layer    =     132.000 in
Distance from top of pile to bottom of layer =     282.000 in

Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =     282.000 in
Distance from top of pile to bottom of layer =     396.000 in

Layer  5 is stiff clay without free water
Distance from top of pile to top of layer    =     396.000 in
Distance from top of pile to bottom of layer =     462.000 in


(Depth of lowest layer extends   78.00 in below pile tip)


------------------------------------------------------------------------------
                   Effective Unit Weight of Soil vs. Depth
------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 10 points
```

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.03100
10	462.00	0.03100

```
------------------------------------------------------------------------------
                           Shear Strength of Soils
------------------------------------------------------------------------------

Shear strength parameters with depth defined using 10 points
```

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	55.55000	0.00	------	------
4	132.000	55.55000	0.00	------	------
5	132.000	55.55000	0.00	------	------
6	282.000	55.55000	0.00	------	------
7	282.000	55.55000	0.00	------	------
8	396.000	55.55000	0.00	------	------
9	396.000	55.55000	0.00	------	------
10	462.000	55.55000	0.00	------	------

```
Notes:

(1)  Cohesion = uniaxial compressive strength for rock materials.
(2)  Values of E50 are reported for clay strata.
(3)  Default values will be generated for E50 when input values are 0.
(4)  RQD and k_rm are reported only for weak rock strata.



------------------------------------------------------------------------------
                           p-y Modification Factors
------------------------------------------------------------------------------
```

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	1.0000	1.0000
3	42.000	1.0000	1.0000
4	1200.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

```
Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =      221503.000 lbs
Bending moment at pile head =   235128000.000 in-lbs
Axial load at pile head     =      117367.000 lbs
```

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Output of p-y Curves at Specified Depths

---

p-y curves are generated and printed for verification at 3 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	48.000
2	174.000	162.000
3	348.000	336.000

Depth of ground surface below top of pile = 12.00 in

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Number of sections = 1

Pile Section No. 1

The sectional shape is a circular drilled shaft (bored pile).

```
Outside Diameter                       =     132.0000 in
```

Material Properties:

```
Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =           90
Area of Single Bar                     =      1.27000 in**2
```

Number of Rows of Reinforcing Bars	=	45
Area of Steel	=	114.300 in**2
Area of Shaft	=	13684.778 in**2
Percentage of Steel Reinforcement	=	0.835 percent
Cover Thickness (edge to bar center)	=	4.000 in

Unfactored Axial Squash Load Capacity = 52997.63 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	2.540	61.962
2	2.540	61.660
3	2.540	61.058
4	2.540	60.158
5	2.540	58.966
6	2.540	57.485
7	2.540	55.725
8	2.540	53.694
9	2.540	51.400
10	2.540	48.857
11	2.540	46.075
12	2.540	43.069
13	2.540	39.853
14	2.540	36.443
15	2.540	32.855
16	2.540	29.107
17	2.540	25.218
18	2.540	21.205
19	2.540	17.090
20	2.540	12.891
21	2.540	8.629
22	2.540	4.325
23	2.540	0.000
24	2.540	-4.325
25	2.540	-8.629
26	2.540	-12.891
27	2.540	-17.090
28	2.540	-21.205
29	2.540	-25.218
30	2.540	-29.107
31	2.540	-32.855
32	2.540	-36.443
33	2.540	-39.853
34	2.540	-43.069
35	2.540	-46.075
36	2.540	-48.857
37	2.540	-51.400
38	2.540	-53.694
39	2.540	-55.725
40	2.540	-57.485
41	2.540	-58.966
42	2.540	-60.158
43	2.540	-61.058
44	2.540	-61.660
45	2.540	-61.962

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25181408.	6.043538E+13	4.166667E-07	0.00002759	66.21742111	97.95383531	751.33747
50136430.	6.016372E+13	8.333333E-07	0.00005518	66.21697265	194.47463	1502.66409
74865067.	5.989205E+13	0.00000125	0.00008277	66.21652025	289.56242	2253.97974
99367320.	5.962039E+13	0.00000167	0.00011036	66.21605998	383.21724	3005.28408
1.236432E+08	5.934873E+13	0.00000208	0.00013795	66.21559578	475.43913	3756.57705
1.236432E+08	4.945727E+13	0.00000250	0.00007949	31.79650587	273.35193	6972.01509
1.236432E+08	4.239195E+13	0.00000292	0.00009280	31.81586856	317.99257	8132.37985
1.236432E+08	3.709296E+13	0.00000333	0.00010612	31.83531779	362.36870	9292.26830
1.236432E+08	3.297152E+13	0.00000375	0.00011946	31.85484964	406.47939	10451.67775
1.236432E+08	2.967436E+13	0.00000417	0.00013281	31.87446803	450.32382	11610.60473
1.236432E+08	2.697670E+13	0.00000458	0.00014618	31.89417690	493.90115	12769.04556
1.236432E+08	2.472864E+13	0.00000500	0.00015957	31.91396838	537.21037	13926.99812
1.236432E+08	2.282643E+13	0.00000542	0.00017298	31.93385428	580.25077	15084.45755
1.236432E+08	2.119597E+13	0.00000583	0.00018640	31.95382673	623.02128	16241.42177

1.236432E+08	1.978291E+13	0.00000625	0.00019984	31.97388965	665.52107	17397.88692
1.236432E+08	1.854648E+13	0.00000667	0.00021329	31.99404305	707.74918	18553.84972
1.236432E+08	1.745551E+13	0.00000708	0.00022677	32.01428694	749.70467	19709.30690
1.236432E+08	1.648576E+13	0.00000750	0.00024026	32.03462523	791.38666	20864.25431
1.236432E+08	1.561809E+13	0.00000792	0.00025377	32.05505794	832.79420	22018.68854
1.236432E+08	1.483718E+13	0.00000833	0.00026730	32.07558507	873.92631	23172.60617
1.236432E+08	1.413065E+13	0.00000875	0.00028084	32.09620661	914.78199	24326.00376
1.236432E+08	1.348835E+13	0.00000917	0.00029441	32.11692256	955.36025	25478.87790
1.236432E+08	1.290190E+13	0.00000958	0.00030799	32.13773686	995.66017	26631.22407
1.253513E+08	1.253513E+13	0.00001000	0.00032159	32.15864950	1035.68073	27783.03871
1.305096E+08	1.252892E+13	0.00001042	0.00033520	32.17966443	1075.42102	28934.31707
1.356625E+08	1.252269E+13	0.00001083	0.00034884	32.20077378	1114.87976	30085.05790
1.408098E+08	1.251643E+13	0.00001125	0.00036250	32.22198540	1154.05612	31235.25522
1.459517E+08	1.251015E+13	0.00001167	0.00037617	32.24330324	1192.94917	32384.90399
1.510881E+08	1.250384E+13	0.00001208	0.00038987	32.26471943	1231.55756	33534.00311
1.562189E+08	1.249751E+13	0.00001250	0.00040358	32.28624183	1269.88047	34682.54617
1.613441E+08	1.249116E+13	0.00001292	0.00041731	32.30786651	1307.91664	35830.53080
1.664637E+08	1.248477E+13	0.00001333	0.00043106	32.32959741	1345.66510	36977.95176
1.715776E+08	1.247837E+13	0.00001375	0.00044483	32.35143453	1383.12470	38124.80520
1.766858E+08	1.247194E+13	0.00001417	0.00045862	32.37338179	1420.29446	39271.08566
1.817883E+08	1.246548E+13	0.00001458	0.00047243	32.39543921	1457.17321	40416.78915
1.868850E+08	1.245900E+13	0.00001500	0.00048626	32.41760284	1493.75962	41561.91337
1.919759E+08	1.245249E+13	0.00001542	0.00050011	32.43988055	1530.05281	42706.45097
1.970610E+08	1.244596E+13	0.00001583	0.00051399	32.46227235	1566.05158	43850.39781
2.021402E+08	1.243940E+13	0.00001625	0.00052788	32.48477429	1601.75456	44993.75160
2.122808E+08	1.242619E+13	0.00001708	0.00055572	32.53012437	1672.26881	47278.65630
2.223975E+08	1.241288E+13	0.00001792	0.00058365	32.57594651	1741.58621	49561.12379
2.324898E+08	1.239946E+13	0.00001875	0.00061167	32.62224466	1809.69661	51841.11772
2.425576E+08	1.238592E+13	0.00001958	0.00063977	32.66903061	1876.59000	54118.59688
2.526004E+08	1.237227E+13	0.00002042	0.00066796	32.71631223	1942.25590	56393.52123
2.626180E+08	1.235850E+13	0.00002125	0.00069624	32.76410919	2006.68416	58665.84273
2.721121E+08	1.232206E+13	0.00002208	0.00072411	32.78967565	2068.72058	60000.00000
2.795383E+08	1.219804E+13	0.00002292	0.00074996	32.72565132	2124.87068	60000.00000
2.858830E+08	1.203718E+13	0.00002375	0.00077475	32.62121004	2177.48620	60000.00000
2.913909E+08	1.185319E+13	0.00002458	0.00079869	32.48905045	2227.16671	60000.00000
2.963306E+08	1.165891E+13	0.00002542	0.00082203	32.34232360	2274.58154	60000.00000
3.007969E+08	1.145893E+13	0.00002625	0.00084487	32.18566364	2319.98265	60000.00000
3.048770E+08	1.125700E+13	0.00002708	0.00086729	32.02311462	2363.60474	60000.00000
3.086357E+08	1.105561E+13	0.00002792	0.00088936	31.85755616	2405.62971	60000.00000
3.120117E+08	1.085258E+13	0.00002875	0.00091096	31.68568772	2445.90409	60000.00000
3.151933E+08	1.065442E+13	0.00002958	0.00093235	31.51608127	2484.93178	60000.00000
3.181679E+08	1.046031E+13	0.00003042	0.00095350	31.34785169	2522.69974	60000.00000
3.208838E+08	1.026828E+13	0.00003125	0.00097431	31.17791480	2559.06830	60000.00000
3.235065E+08	1.008332E+13	0.00003208	0.00099503	31.01396137	2594.50546	60000.00000
3.258804E+08	9.900165E+12	0.00003292	0.00101541	30.84788758	2628.58566	60000.00000
3.283735E+08	9.729584E+12	0.00003375	0.00103936	30.79570431	2667.96070	60000.00000
3.305070E+08	9.556830E+12	0.00003458	0.00105898	30.62122375	2699.19589	60000.00000
3.324844E+08	9.387796E+12	0.00003542	0.00107837	30.44806498	2729.35608	60000.00000
3.344561E+08	9.226374E+12	0.00003625	0.00109779	30.28375357	2758.90365	60000.00000
3.361933E+08	9.065887E+12	0.00003708	0.00111678	30.11552793	2787.13879	60000.00000
3.378986E+08	8.911611E+12	0.00003792	0.00113576	29.95411187	2814.70462	60000.00000
3.395986E+08	8.763835E+12	0.00003875	0.00115477	29.80043381	2841.68159	60000.00000
3.410842E+08	8.616863E+12	0.00003958	0.00117336	29.64275891	2867.42591	60000.00000
3.425468E+08	8.475384E+12	0.00004042	0.00119194	29.49135464	2892.54946	60000.00000
3.440045E+08	8.339502E+12	0.00004125	0.00121055	29.34677964	2917.10627	60000.00000
3.453646E+08	8.206683E+12	0.00004208	0.00122898	29.20355004	2940.80774	60000.00000
3.466128E+08	8.076414E+12	0.00004292	0.00124719	29.06078070	2963.62760	60000.00000
3.478564E+08	7.951003E+12	0.00004375	0.00126543	28.92408925	2985.90138	60000.00000
3.490955E+08	7.830178E+12	0.00004458	0.00128369	28.79314131	3007.62660	60000.00000
3.502570E+08	7.712081E+12	0.00004542	0.00130180	28.66357809	3028.57976	60000.00000
3.506722E+08	7.582101E+12	0.00004625	0.00132275	28.59999830	3052.26388	60000.00000
3.526325E+08	7.489539E+12	0.00004708	0.00134318	28.52766949	3074.58539	60000.00000
3.536482E+08	7.380485E+12	0.00004792	0.00136049	28.39274830	3092.76550	60000.00000
3.546602E+08	7.275081E+12	0.00004875	0.00137782	28.26298445	3110.45125	60000.00000
3.555833E+08	7.171429E+12	0.00004958	0.00139492	28.13280362	3127.36882	60000.00000
3.572817E+08	6.971350E+12	0.00005125	0.00142876	27.87832314	3159.33829	60000.00000
3.589660E+08	6.783609E+12	0.00005292	0.00146271	27.64178127	3189.40607	60000.00000
3.605100E+08	6.604763E+12	0.00005458	0.00149633	27.41359109	3217.18780	60000.00000
3.619065E+08	6.433893E+12	0.00005625	0.00152958	27.19245046	3242.72053	60000.00000
3.632898E+08	6.272629E+12	0.00005792	0.00156292	26.98574334	3266.40488	60000.00000
3.646301E+08	6.119666E+12	0.00005958	0.00159626	26.79034621	3288.14756	60000.00000
3.657706E+08	5.971764E+12	0.00006125	0.00162897	26.59535033	3307.58501	60000.00000
3.668986E+08	5.831501E+12	0.00006292	0.00166177	26.41222304	3325.22083	60000.00000
3.683458E+08	5.703419E+12	0.00006458	0.00170424	26.38820261	3345.53088	60000.00000
3.693951E+08	5.575775E+12	0.00006625	0.00173585	26.20158201	3358.37736	60000.00000
3.702605E+08	5.451689E+12	0.00006792	0.00176669	26.01267189	3369.23024	60000.00000
3.711042E+08	5.333234E+12	0.00006958	0.00179757	25.83327788	3378.45625	60000.00000
3.719375E+08	5.220176E+12	0.00007125	0.00182853	25.66355735	3386.06356	60000.00000
3.727603E+08	5.112142E+12	0.00007292	0.00185958	25.50286120	3392.03686	60000.00000
3.735690E+08	5.008747E+12	0.00007458	0.00189071	25.35032791	3396.35813	60000.00000
3.742233E+08	4.907847E+12	0.00007625	0.00192109	25.19463569	3398.96330	60000.00000

3.748678E+08	4.811137E+12	0.00007792	0.00195156	25.04676408	3399.98441	60000.00000
3.754819E+08	4.718097E+12	0.00007958	0.00198212	24.90622920	3393.47093	60000.00000
3.760877E+08	4.628772E+12	0.00008125	0.00201277	24.77259833	3385.85592	60000.00000
3.766889E+08	4.542982E+12	0.00008292	0.00204352	24.64547020	3390.28101	60000.00000
3.772852E+08	4.460514E+12	0.00008458	0.00207436	24.52446717	3394.58368	60000.00000
3.777768E+08	4.380021E+12	0.00008625	0.00210460	24.40119034	3397.57963	60000.00000
3.782499E+08	4.302369E+12	0.00008792	0.00213484	24.28250831	3399.38470	60000.00000
3.782499E+08	4.222325E+12	0.00008958	0.00216792	24.19999856	3399.35998	60000.00000
3.785457E+08	4.148446E+12	0.00009125	0.00220825	24.19999856	3390.15594	60000.00000
3.799668E+08	4.089329E+12	0.00009292	0.00224281	24.13785464	3382.47763	60000.00000
3.803819E+08	4.021659E+12	0.00009458	0.00227198	24.02094680	3386.43806	60000.00000
3.807947E+08	3.956308E+12	0.00009625	0.00230122	23.90880686	3390.65692	60000.00000
3.812051E+08	3.893158E+12	0.00009792	0.00233053	23.80120665	3394.10273	60000.00000
3.815485E+08	3.831449E+12	0.00009958	0.00235927	23.69145066	3396.69455	60000.00000
3.818629E+08	3.771485E+12	0.00010125	0.00238781	23.58331937	3398.52615	60000.00000
3.821752E+08	3.713443E+12	0.00010292	0.00241642	23.47933835	3399.63052	60000.00000
3.824854E+08	3.657231E+12	0.00010458	0.00244509	23.37932271	3399.99740	60000.00000
3.827868E+08	3.602699E+12	0.00010625	0.00247398	23.28455490	3394.78418	60000.00000
3.830870E+08	3.549841E+12	0.00010792	0.00250293	23.19314665	3389.55864	60000.00000
3.833650E+08	3.498388E+12	0.00010958	0.00253235	23.10890204	3384.20618	60000.00000
3.836295E+08	3.448355E+12	0.00011125	0.00256208	23.02995247	3378.77226	60000.00000
3.838801E+08	3.399676E+12	0.00011292	0.00259213	22.95616418	3378.93161	60000.00000
3.841291E+08	3.352399E+12	0.00011458	0.00262224	22.88501555	3383.58659	60000.00000
3.843353E+08	3.306110E+12	0.00011625	0.00265216	22.81430358	3387.62034	60000.00000
3.846572E+08	3.216645E+12	0.00011958	0.00271194	22.67823368	3393.97390	60000.00000
3.849731E+08	3.131985E+12	0.00012292	0.00277195	22.55147141	3398.08523	60000.00000
3.852586E+08	3.051553E+12	0.00012625	0.00283283	22.43823391	3399.91839	60000.00000
3.855131E+08	2.975021E+12	0.00012958	0.00289462	22.33791929	3392.87606	60000.00000
3.857602E+08	2.902271E+12	0.00013292	0.00295670	22.24478406	3383.25441	60000.00000
3.860036E+08	2.833054E+12	0.00013625	0.00301896	22.15749854	3373.58622	60000.00000
3.862154E+08	2.766917E+12	0.00013958	0.00308218	22.08129877	3372.04150	60000.00000
3.863390E+08	2.703247E+12	0.00014292	0.00314428	22.00082678	3380.81542	60000.00000
3.878648E+08	2.652067E+12	0.00014625	0.00321750	22.00000066	3390.22842	60000.00000
3.893390E+08	2.602824E+12	0.00014958	0.00329083	22.00000066	3396.50984	60000.00000
3.907463E+08	2.555289E+12	0.00015292	0.00336417	22.00000066	3399.62741	60000.00000
3.918816E+08	2.508043E+12	0.00015625	0.00343750	22.00000066	3394.51569	60000.00000
3.918816E+08	2.455655E+12	0.00015958	0.00350985	21.99381262	3384.11931	60000.00000
3.918816E+08	2.405412E+12	0.00016292	0.00357301	21.93154281	3376.14802	60000.00000
3.918816E+08	2.357183E+12	0.00016625	0.00363634	21.87275058	3368.13365	60000.00000
3.918816E+08	2.310850E+12	0.00016958	0.00369984	21.81725496	3360.07514	60000.00000
3.918816E+08	2.266304E+12	0.00017292	0.00376351	21.76489466	3361.62745	60000.00000
3.918816E+08	2.223442E+12	0.00017625	0.00382736	21.71552414	3370.17444	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 385929.47495 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number            =          1
Depth below pile head        =      60.000 in
Depth below ground surface   =      48.000 in
Equivalent Depth (see note)  =      48.000 in
Pile Diameter                =     132.000 in
Angle of Friction            =      46.000 deg.
Avg. Eff. Unit Weight        =     0.05300 pci
k                            =     225.000 pci
A (static)                   =      2.5755
B (static)                   =      1.9145
Pst                          =    2979.144 lbs/in
Psd                          =   82368.160 lbs/in
Ps                           =    2979.144 lbs/in
Cbar                         =   4587.6751
n                            =      3.6210
m                            =    715.9795
yk                           =      0.3064 in
pm                           =    5703.707 lbs/in
ym                           =      2.2000 in
pu                           =    7672.651 lbs/in
yu                           =      4.9500 in
p-multiplier                 =     1.00000
y-multiplier                 =     1.00000
```

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in
0.0000	0.0000
0.1833333	1980.0000
0.3666667	3477.4460

```
      0.5500000       3889.4693
      0.7333333       4211.0834
      0.9166667       4478.7502
         1.1000       4710.0313
         1.2833       4914.8701
         1.4667       5099.4965
         1.6500       5268.0968
         1.8333       5423.6329
         2.0167       5568.2847
         2.2000       5703.7075
         3.5750       6688.1793
         4.9500       7672.6512
       136.9500       7672.6512
       268.9500       7672.6512

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.




p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =          3
Depth below pile head      =      174.000 in
Depth below ground surface =      162.000 in
Equivalent Depth           =      113.426 in
Diameter                   =      132.000 in
Undrained cohesion, c      =     55.55000 lbs/in**2
Average Eff. Unit Weight   =      0.06404 lbs/in**3
Epsilon-50                 =      0.00400
Pct                        =    26106.972 lbs/in
Pcd                        =    65993.400 lbs/in
Pu                         =    26106.972 lbs/in
y50                        =        1.320 in
p-multiplier               =      1.00000
y-multiplier               =      1.00000

        y, in            p, lbs/in
----------------    -----------------
         0.0000           0.0000
      0.0002112       1468.1029
      0.0010560       2195.3259
      0.0021120       2610.6972
      0.0105600       3903.9029
      0.0211200       4642.5491
      0.1056000       6942.2300
      0.2112000       8255.7493
      0.5280000      10381.0552
         1.0560      12345.2247
         1.5840      13662.2371
         2.1120      14681.0291
         5.2800      18460.4167
        10.5600      21953.2589
        21.1200      26106.9717
        23.7600      26106.9717
        26.4000      26106.9717




p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number          =          4
Depth below pile head      =      348.000 in
Depth below ground surface =      336.000 in
Equivalent Depth           =      285.366 in
Diameter                   =      132.000 in
Undrained cohesion, c      =     55.55000 lbs/in**2
Average Eff. Unit Weight   =      0.06616 lbs/in**3
Epsilon-50                 =      0.00400
Pct                        =    32415.991 lbs/in
Pcd                        =    65993.400 lbs/in
Pu                         =    32415.991 lbs/in
y50                        =        1.320 in
p-multiplier               =      1.00000
y-multiplier               =      1.00000
```

y, in	p, lbs/in
0.0000	0.0000
0.0002112	1822.8851
0.0010560	2725.8490
0.0021120	3241.5990
0.0105600	4847.3213
0.0211200	5764.4689
0.1056000	8619.8915
0.2112000	10250.8363
0.5280000	12889.7443
1.0560	15328.5756
1.5840	16963.8576
2.1120	18228.8512
5.2800	22921.5668
10.5600	27258.4903
21.1200	32415.9907
23.7600	32415.9907
26.4000	32415.9907

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 221503.000 lbs
Specified moment at pile head = 235128000.000 in-lbs
Specified axial load at pile head = 117367.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	1.507	2.35E+08	2.22E+05	-0.008516	1049.893	1.24E+13	0.000	0.000
3.840	1.474	2.36E+08	2.22E+05	-0.008443	1053.676	1.24E+13	0.000	0.000
7.680	1.442	2.37E+08	2.22E+05	-0.008370	1057.460	1.24E+13	0.000	0.000
11.520	1.410	2.38E+08	2.22E+05	-0.008297	1061.244	1.24E+13	0.000	0.000
15.360	1.378	2.39E+08	2.21E+05	-0.008223	1065.027	1.24E+13	-30.549	85.131
19.200	1.347	2.39E+08	2.21E+05	-0.008149	1068.808	1.24E+13	-143.380	408.881
23.040	1.315	2.40E+08	2.20E+05	-0.008074	1072.580	1.24E+13	-344.025	1004.295
26.880	1.285	2.41E+08	2.18E+05	-0.008000	1076.329	1.24E+13	-636.862	1903.829
30.720	1.254	2.42E+08	2.15E+05	-0.007925	1080.037	1.24E+13	-1025.727	3141.068
34.560	1.224	2.43E+08	2.10E+05	-0.007850	1083.677	1.24E+13	-1513.915	4750.785
38.400	1.194	2.44E+08	2.03E+05	-0.007774	1087.218	1.24E+13	-2104.176	6769.012
42.240	1.164	2.44E+08	1.94E+05	-0.007699	1090.622	1.24E+13	-2776.505	9159.829
46.080	1.135	2.45E+08	1.82E+05	-0.007623	1093.844	1.24E+13	-3168.315	10723.
49.920	1.105	2.46E+08	1.70E+05	-0.007547	1096.860	1.24E+13	-3565.480	12386.
53.760	1.077	2.46E+08	1.55E+05	-0.007470	1099.642	1.24E+13	-3966.942	14149.
57.600	1.048	2.47E+08	1.39E+05	-0.007394	1102.165	1.24E+13	-4371.643	16017.
61.440	1.020	2.47E+08	1.22E+05	-0.007317	1104.402	1.24E+13	-4778.526	17993.
65.280	0.991858	2.48E+08	1.02E+05	-0.007240	1106.327	1.24E+13	-5186.534	20080.
69.120	0.964203	2.48E+08	81689.	-0.007163	1107.913	1.24E+13	-5594.612	22281.
72.960	0.936843	2.49E+08	51156.	-0.007086	1109.134	1.24E+13	-10308.	42251.
76.800	0.909779	2.49E+08	11599.	-0.007009	1109.682	1.24E+13	-10295.	43453.
80.640	0.883011	2.49E+08	-27906.	-0.006932	1109.557	1.24E+13	-10280.	44706.
84.480	0.856539	2.48E+08	-67351.	-0.006855	1108.760	1.24E+13	-10264.	46016.
88.320	0.830364	2.48E+08	-1.07E+05	-0.006778	1107.293	1.24E+13	-10247.	47385.
92.160	0.804484	2.48E+08	-1.46E+05	-0.006701	1105.157	1.24E+13	-10227.	48816.
96.000	0.778899	2.47E+08	-1.85E+05	-0.006624	1102.353	1.24E+13	-10206.	50315.
99.840	0.753608	2.46E+08	-2.24E+05	-0.006548	1098.882	1.24E+13	-10183.	51886.
103.680	0.728610	2.45E+08	-2.63E+05	-0.006472	1094.746	1.24E+13	-10158.	53534.
107.520	0.703904	2.44E+08	-3.02E+05	-0.006396	1089.946	1.24E+13	-10130.	55264.
111.360	0.679489	2.43E+08	-3.41E+05	-0.006320	1084.485	1.24E+13	-10101.	57083.
115.200	0.655364	2.42E+08	-3.80E+05	-0.006245	1078.364	1.24E+13	-10069.	58998.
119.040	0.631525	2.40E+08	-4.19E+05	-0.006171	1071.586	1.24E+13	-10035.	61017.
122.880	0.607973	2.38E+08	-4.57E+05	-0.006097	1064.151	1.24E+13	-9998.167	63149.
126.720	0.584704	2.37E+08	-4.95E+05	-0.006023	1056.064	1.24E+13	-9958.768	65403.
130.560	0.561717	2.35E+08	-5.34E+05	-0.005950	1047.326	1.24E+13	-9916.565	67791.
134.400	0.539008	2.32E+08	-5.72E+05	-0.005878	1037.941	1.24E+13	-9857.668	70228.
138.240	0.516576	2.30E+08	-6.09E+05	-0.005806	1027.912	1.24E+13	-9808.773	72914.
142.080	0.494418	2.28E+08	-6.47E+05	-0.005735	1017.242	1.24E+13	-9756.574	75776.
145.920	0.472530	2.25E+08	-6.84E+05	-0.005665	1005.934	1.24E+13	-9700.877	78834.
149.760	0.450910	2.23E+08	-7.21E+05	-0.005596	993.993	1.24E+13	-9641.465	82108.
153.600	0.429554	2.20E+08	-7.58E+05	-0.005527	981.423	1.24E+13	-9578.097	85623.
157.440	0.408459	2.17E+08	-7.95E+05	-0.005460	968.226	1.24E+13	-9510.501	89410.

161.280	0.387622	2.14E+08	-8.31E+05	-0.005393	954.409	1.24E+13	-9438.372	93502.
165.120	0.367038	2.10E+08	-8.67E+05	-0.005328	939.975	1.24E+13	-9361.363	97940.
168.960	0.346703	2.07E+08	-9.03E+05	-0.005264	924.929	1.24E+13	-9279.078	1.03E+05
172.800	0.326614	2.03E+08	-9.39E+05	-0.005200	909.277	1.24E+13	-9191.063	1.08E+05
176.640	0.306766	2.00E+08	-9.74E+05	-0.005138	893.025	1.24E+13	-9096.793	1.14E+05
180.480	0.287154	1.96E+08	-1.01E+06	-0.005077	876.179	1.24E+13	-8995.656	1.20E+05
184.320	0.267775	1.92E+08	-1.04E+06	-0.005017	858.746	1.25E+13	-8886.934	1.27E+05
188.160	0.248623	1.88E+08	-1.08E+06	-0.004959	840.731	1.25E+13	-8769.772	1.35E+05
192.000	0.229693	1.84E+08	-1.11E+06	-0.004901	822.144	1.25E+13	-8643.146	1.44E+05
195.840	0.210981	1.79E+08	-1.14E+06	-0.004845	802.993	1.25E+13	-8505.812	1.55E+05
199.680	0.192481	1.75E+08	-1.18E+06	-0.004791	783.286	1.25E+13	-8356.231	1.67E+05
203.520	0.174187	1.70E+08	-1.21E+06	-0.004738	763.033	1.25E+13	-8192.471	1.81E+05
207.360	0.156095	1.66E+08	-1.24E+06	-0.004686	742.245	1.25E+13	-8012.057	1.97E+05
211.200	0.138199	1.61E+08	-1.27E+06	-0.004636	720.933	1.25E+13	-7811.732	2.17E+05
215.040	0.120492	1.56E+08	-1.30E+06	-0.004587	699.112	1.25E+13	-7587.079	2.42E+05
218.880	0.102970	1.51E+08	-1.33E+06	-0.004540	676.795	1.25E+13	-7331.870	2.73E+05
222.720	0.085625	1.46E+08	-1.35E+06	-0.004494	653.999	1.25E+13	-7036.868	3.16E+05
226.560	0.068452	1.40E+08	-1.38E+06	-0.004451	630.743	1.25E+13	-6687.399	3.75E+05
230.400	0.051445	1.35E+08	-1.41E+06	-0.004408	607.050	1.25E+13	-6257.731	4.67E+05
234.240	0.034596	1.30E+08	-1.43E+06	-0.004368	582.949	1.25E+13	-5695.102	6.32E+05
238.080	0.017901	1.24E+08	-1.45E+06	-0.004343	558.476	5.14E+13	-4854.210	1.04E+06
241.920	0.001241	1.19E+08	-1.46E+06	-0.004335	533.686	5.94E+13	-1420.482	4.40E+06
245.760	-0.015390	1.13E+08	-1.45E+06	-0.004327	508.803	5.95E+13	4719.866	1.18E+06
249.600	-0.031993	1.07E+08	-1.43E+06	-0.004320	484.228	5.95E+13	5695.250	6.84E+05
253.440	-0.048569	1.02E+08	-1.41E+06	-0.004313	460.025	5.96E+13	6352.586	5.02E+05
257.280	-0.065119	9.66E+07	-1.39E+06	-0.004307	436.237	5.96E+13	6868.917	4.05E+05
261.120	-0.081646	9.13E+07	-1.36E+06	-0.004301	412.897	5.97E+13	7303.535	3.44E+05
264.960	-0.098150	8.61E+07	-1.33E+06	-0.004295	390.035	5.97E+13	7684.228	3.01E+05
268.800	-0.114634	8.11E+07	-1.30E+06	-0.004290	367.674	5.98E+13	8026.441	2.69E+05
272.640	-0.131097	7.62E+07	-1.27E+06	-0.004285	345.837	5.99E+13	8339.712	2.44E+05
276.480	-0.147541	7.13E+07	-1.24E+06	-0.004280	324.545	5.99E+13	8630.375	2.25E+05
280.320	-0.163968	6.67E+07	-1.20E+06	-0.004276	303.817	6.00E+13	8902.867	2.08E+05
284.160	-0.180378	6.21E+07	-1.17E+06	-0.004272	283.670	6.00E+13	9137.848	1.95E+05
288.000	-0.196773	5.77E+07	-1.13E+06	-0.004268	264.120	6.01E+13	9382.792	1.83E+05
291.840	-0.213154	5.34E+07	-1.10E+06	-0.004264	245.182	6.01E+13	9617.169	1.73E+05
295.680	-0.229522	4.93E+07	-1.06E+06	-0.004261	226.873	6.02E+13	9842.462	1.65E+05
299.520	-0.245878	4.53E+07	-1.02E+06	-0.004258	209.206	6.02E+13	10060.	1.57E+05
303.360	-0.262222	4.15E+07	-9.81E+05	-0.004255	192.196	6.02E+13	10270.	1.50E+05
307.200	-0.278557	3.78E+07	-9.41E+05	-0.004253	175.857	6.03E+13	10475.	1.44E+05
311.040	-0.294882	3.42E+07	-9.01E+05	-0.004250	160.202	6.03E+13	10674.	1.39E+05
314.880	-0.311199	3.09E+07	-8.59E+05	-0.004248	145.244	6.03E+13	10868.	1.34E+05
318.720	-0.327508	2.76E+07	-8.17E+05	-0.004246	130.995	6.04E+13	11057.	1.30E+05
322.560	-0.343811	2.46E+07	-7.74E+05	-0.004245	117.469	6.04E+13	11243.	1.26E+05
326.400	-0.360107	2.17E+07	-7.31E+05	-0.004243	104.677	6.04E+13	11425.	1.22E+05
330.240	-0.376399	1.90E+07	-6.87E+05	-0.004242	92.631	6.04E+13	11604.	1.18E+05
334.080	-0.392685	1.64E+07	-6.42E+05	-0.004241	81.343	6.04E+13	11780.	1.15E+05
337.920	-0.408968	1.41E+07	-5.96E+05	-0.004240	70.824	6.04E+13	11953.	1.12E+05
341.760	-0.425247	1.19E+07	-5.50E+05	-0.004239	61.086	6.04E+13	12124.	1.09E+05
345.600	-0.441523	9.84E+06	-5.03E+05	-0.004238	52.139	6.04E+13	12292.	1.07E+05
349.440	-0.457797	8.00E+06	-4.55E+05	-0.004238	43.996	6.04E+13	12458.	1.05E+05
353.280	-0.474069	6.34E+06	-4.07E+05	-0.004237	36.665	6.04E+13	12623.	1.02E+05
357.120	-0.490340	4.87E+06	-3.59E+05	-0.004237	30.160	6.04E+13	12785.	1.00E+05
360.960	-0.506609	3.59E+06	-3.09E+05	-0.004237	24.489	6.04E+13	12946.	98125.
364.800	-0.522877	2.50E+06	-2.59E+05	-0.004236	19.663	6.04E+13	13105.	96239.
368.640	-0.539145	1.61E+06	-2.08E+05	-0.004236	15.693	6.04E+13	13262.	94457.
372.480	-0.555412	9.06E+05	-1.57E+05	-0.004236	12.590	6.04E+13	13418.	92769.
376.320	-0.571680	4.03E+05	-1.05E+05	-0.004236	10.362	6.04E+13	13573.	91169.
380.160	-0.587947	1.00E+05	-53001.	-0.004236	9.021	6.04E+13	13726.	89649.
384.000	-0.604214	0.000	0.000	-0.004236	8.576	6.04E+13	13879.	44102.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection            =     1.50654859 in
Computed slope at pile head     =    -0.00851629
Maximum bending moment          =   2.486283E+08 lbs-in
Maximum shear force             =       -1460947. lbs
Depth of maximum bending moment =    76.80000000 in
Depth of maximum shear force    =      241.92000 in
Number of iterations            =             42
Number of zero deflection points =             1
```

```
-------------------------------------------------------------------------------
                           Summary of Pile Response(s)
-------------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2            lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  2.22E+05 M=  2.35E+08     117367.      1.5065  2.4863E+08   -1460947.


---------------------------------------------------------------------------------
                       Pile-head Deflection vs. Pile Length
---------------------------------------------------------------------------------

Boundary Condition Type 1, Shear and Moment

Shear      =         221503. lbs
Moment     =      235128000. in-lbs
Axial Load =         117367. lbs


   Pile       Pile Head       Maximum      Maximum
  Length      Deflection      Moment        Shear
    in           in           in-lbs         lbs
-----------  ------------  ------------  ------------
   384.000    1.50654859  2.486283E+08     -1460947.
   364.800    2.23573685  2.482456E+08     -1760444.
   345.600    3.53918389  2.478006E+08     -1641698.
   326.400    6.06788503  2.471506E+08     -1749405.
   307.200   11.52039768  2.472837E+08     -1889824.
   288.000   24.52296476  2.478854E+08     -2069810.

The analysis ended normally.
```

B.14 Undrained Analysis from CPT (Ultimate

```
=================================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method
                          (c) 1985-2010 by Ensoft, Inc.
                               All Rights Reserved

=================================================================================

This program is licensed to:

Zach McClellan
University Of Utah

---------------------------------------------------------------------------------
                            Files Used for Analysis
---------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using CPT Undrained Shear Strengths.lpd
Name of output file:         Drilled Shaft Analysis Using CPT Undrained Shear Strengths.lpo
Name of plot output file:    Drilled Shaft Analysis Using CPT Undrained Shear Strengths.lpp
```

```
Name of runtime file:       Drilled Shaft Analysis Using CPT Undrained Shear Strengths.lpr

--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:  10:24:32

--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Drilled Shaft Analysis Using Undrained Parameters from CPT


--------------------------------------------------------------------------------
                                Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs.
  pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments            =         100
- Maximum number of iterations allowed =         100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


--------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                               =     384.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface             =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
           in           in         in**4         Sq.in     lbs/Sq.in
-----  ---------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000    14902723.   13685.0000      3604997.
  2     384.0000     132.00000    14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------
```

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 12.000 in
Distance from top of pile to bottom of layer = 72.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = 72.000 in
Distance from top of pile to bottom of layer = 132.000 in

Layer 3 is stiff clay without free water
Distance from top of pile to top of layer = 132.000 in
Distance from top of pile to bottom of layer = 282.000 in

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 282.000 in
Distance from top of pile to bottom of layer = 396.000 in

Layer 5 is stiff clay without free water
Distance from top of pile to top of layer = 396.000 in
Distance from top of pile to bottom of layer = 462.000 in

(Depth of lowest layer extends 78.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 10 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05300
2	72.00	0.05300
3	72.00	0.07300
4	132.00	0.07300
5	132.00	0.06700
6	282.00	0.06700
7	282.00	0.07000
8	396.00	0.07000
9	396.00	0.03100
10	462.00	0.03100

Shear Strength of Soils

Shear strength parameters with depth defined using 10 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	55.55000	0.00	------	------
4	132.000	55.55000	0.00	------	------
5	132.000	55.55000	0.00	------	------
6	282.000	55.55000	0.00	------	------
7	282.000	55.55000	0.00	------	------
8	396.000	55.55000	0.00	------	------
9	396.000	55.55000	0.00	------	------
10	462.000	55.55000	0.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	0.0000	1.0000
2	42.000	1.0000	1.0000
3	42.000	1.0000	1.0000
4	1200.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 319693.000 lbs
Bending moment at pile head = 345051000.000 in-lbs
Axial load at pile head = 189766.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Output of p-y Curves at Specified Depths

---

p-y curves are generated and printed for verification at 3 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	48.000
2	174.000	162.000
3	348.000	336.000

Depth of ground surface below top of pile = 12.00 in

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Number of sections = 1

Pile Section No. 1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter = 132.0000 in

Material Properties:

```
Compressive Strength of Concrete       =        4.000 kip/in**2
Yield Stress of Reinforcement          =          60. kip/in**2
Modulus of Elasticity of Reinforcement =       29000. kip/in**2
Number of Reinforcing Bars             =           90
Area of Single Bar                     =      1.27000 in**2
Number of Rows of Reinforcing Bars     =           45
Area of Steel                          =      114.300 in**2
Area of Shaft                          =    13684.778 in**2
Percentage of Steel Reinforcement      =        0.835 percent
Cover Thickness (edge to bar center)   =        4.000 in

Unfactored Axial Squash Load Capacity  =     52997.63 kip
```

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	2.540	61.962
2	2.540	61.660
3	2.540	61.058
4	2.540	60.158
5	2.540	58.966
6	2.540	57.485
7	2.540	55.725
8	2.540	53.694
9	2.540	51.400
10	2.540	48.857
11	2.540	46.075
12	2.540	43.069
13	2.540	39.853
14	2.540	36.443
15	2.540	32.855
16	2.540	29.107
17	2.540	25.218
18	2.540	21.205
19	2.540	17.090
20	2.540	12.891
21	2.540	8.629
22	2.540	4.325
23	2.540	0.000
24	2.540	-4.325
25	2.540	-8.629
26	2.540	-12.891
27	2.540	-17.090
28	2.540	-21.205
29	2.540	-25.218
30	2.540	-29.107
31	2.540	-32.855
32	2.540	-36.443
33	2.540	-39.853
34	2.540	-43.069
35	2.540	-46.075
36	2.540	-48.857
37	2.540	-51.400
38	2.540	-53.694
39	2.540	-55.725
40	2.540	-57.485
41	2.540	-58.966
42	2.540	-60.158
43	2.540	-61.058
44	2.540	-61.660
45	2.540	-61.962

Axial Thrust Force =   0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25181408.	6.043538E+13	4.166667E-07	0.00002759	66.21742111	97.95383531	751.33747
50136430.	6.016372E+13	8.333333E-07	0.00005518	66.21697265	194.47463	1502.66409
74865067.	5.989205E+13	0.00000125	0.00008277	66.21652025	289.56242	2253.97974
99367320.	5.962039E+13	0.00000167	0.00011036	66.21605998	383.21724	3005.28408
1.236432E+08	5.934873E+13	0.00000208	0.00013795	66.21559578	475.43913	3756.57705
1.236432E+08	4.945727E+13	0.00000250	0.00007949	31.79650587	273.35193	6972.01509
1.236432E+08	4.239195E+13	0.00000292	0.00009280	31.81586856	317.99257	8132.37985
1.236432E+08	3.709296E+13	0.00000333	0.00010612	31.83531779	362.36870	9292.26830

1.236432E+08	3.297152E+13	0.00000375	0.00011946	31.85484964	406.47939	10451.67775
1.236432E+08	2.967436E+13	0.00000417	0.00013281	31.87446803	450.32382	11610.60473
1.236432E+08	2.697670E+13	0.00000458	0.00014618	31.89417690	493.90115	12769.04556
1.236432E+08	2.472864E+13	0.00000500	0.00015957	31.91396838	537.21037	13926.99812
1.236432E+08	2.282643E+13	0.00000542	0.00017298	31.93385428	580.25077	15084.45755
1.236432E+08	2.119597E+13	0.00000583	0.00018640	31.95382673	623.02128	16241.42177
1.236432E+08	1.978291E+13	0.00000625	0.00019984	31.97388965	665.52107	17397.88692
1.236432E+08	1.854648E+13	0.00000667	0.00021329	31.99404305	707.74918	18553.84972
1.236432E+08	1.745551E+13	0.00000708	0.00022677	32.01428694	749.70467	19709.30690
1.236432E+08	1.648576E+13	0.00000750	0.00024026	32.03462523	791.38666	20864.25431
1.236432E+08	1.561809E+13	0.00000792	0.00025377	32.05505794	832.79420	22018.68854
1.236432E+08	1.483718E+13	0.00000833	0.00026730	32.07558507	873.92631	23172.60617
1.236432E+08	1.413065E+13	0.00000875	0.00028084	32.09620661	914.78199	24326.00376
1.236432E+08	1.348835E+13	0.00000917	0.00029441	32.11692256	955.36025	25478.87790
1.236432E+08	1.290190E+13	0.00000958	0.00030799	32.13773686	995.66017	26631.22407
1.253513E+08	1.253513E+13	0.00001000	0.00032159	32.15864950	1035.68073	27783.03871
1.305096E+08	1.252892E+13	0.00001042	0.00033520	32.17966443	1075.42102	28934.31707
1.356625E+08	1.252269E+13	0.00001083	0.00034884	32.20077378	1114.87976	30085.05790
1.408098E+08	1.251643E+13	0.00001125	0.00036250	32.22198540	1154.05612	31235.25522
1.459517E+08	1.251015E+13	0.00001167	0.00037617	32.24330324	1192.94917	32384.90399
1.510881E+08	1.250384E+13	0.00001208	0.00038987	32.26471943	1231.55756	33534.00311
1.562189E+08	1.249751E+13	0.00001250	0.00040358	32.28624183	1269.88047	34682.54617
1.613441E+08	1.249116E+13	0.00001292	0.00041731	32.30786651	1307.91664	35830.53080
1.664637E+08	1.248477E+13	0.00001333	0.00043106	32.32959741	1345.66510	36977.95176
1.715776E+08	1.247837E+13	0.00001375	0.00044483	32.35143453	1383.12470	38124.80520
1.766858E+08	1.247194E+13	0.00001417	0.00045862	32.37338179	1420.29446	39271.08566
1.817883E+08	1.246548E+13	0.00001458	0.00047243	32.39543921	1457.17321	40416.78915
1.868850E+08	1.245900E+13	0.00001500	0.00048626	32.41760284	1493.75962	41561.91337
1.919759E+08	1.245249E+13	0.00001542	0.00050011	32.43988055	1530.05281	42706.45097
1.970610E+08	1.244596E+13	0.00001583	0.00051399	32.46227235	1566.05158	43850.39781
2.021402E+08	1.243940E+13	0.00001625	0.00052788	32.48477429	1601.75456	44993.75160
2.122808E+08	1.242619E+13	0.00001708	0.00055572	32.53012437	1672.26881	47278.65630
2.223975E+08	1.241288E+13	0.00001792	0.00058365	32.57594651	1741.58621	49561.12379
2.324898E+08	1.239946E+13	0.00001875	0.00061167	32.62224466	1809.69661	51841.11772
2.425576E+08	1.238592E+13	0.00001958	0.00063977	32.66903061	1876.59000	54118.59688
2.526004E+08	1.237227E+13	0.00002042	0.00066796	32.71631223	1942.25590	56393.52123
2.626180E+08	1.235850E+13	0.00002125	0.00069624	32.76410919	2006.68416	58665.84273
2.721121E+08	1.232206E+13	0.00002208	0.00072411	32.78967565	2068.72058	60000.00000
2.795383E+08	1.219804E+13	0.00002292	0.00074996	32.72565132	2124.87068	60000.00000
2.858830E+08	1.203718E+13	0.00002375	0.00077475	32.62121004	2177.48620	60000.00000
2.913909E+08	1.185319E+13	0.00002458	0.00079869	32.48905045	2227.16671	60000.00000
2.963306E+08	1.165891E+13	0.00002542	0.00082203	32.34232360	2274.58154	60000.00000
3.007969E+08	1.145893E+13	0.00002625	0.00084487	32.18566364	2319.98265	60000.00000
3.048770E+08	1.125700E+13	0.00002708	0.00086729	32.02311462	2363.60474	60000.00000
3.086357E+08	1.105561E+13	0.00002792	0.00088936	31.85755616	2405.62971	60000.00000
3.120117E+08	1.085258E+13	0.00002875	0.00091096	31.68568772	2445.90409	60000.00000
3.151933E+08	1.065442E+13	0.00002958	0.00093235	31.51608127	2484.93178	60000.00000
3.181679E+08	1.046031E+13	0.00003042	0.00095350	31.34785169	2522.69974	60000.00000
3.208838E+08	1.026828E+13	0.00003125	0.00097431	31.17791480	2559.06830	60000.00000
3.235065E+08	1.008332E+13	0.00003208	0.00099503	31.01396137	2594.50546	60000.00000
3.258804E+08	9.900165E+12	0.00003292	0.00101541	30.84788758	2628.58566	60000.00000
3.283735E+08	9.729584E+12	0.00003375	0.00103936	30.79570431	2667.96070	60000.00000
3.305070E+08	9.556830E+12	0.00003458	0.00105898	30.62122375	2699.19589	60000.00000
3.324844E+08	9.387796E+12	0.00003542	0.00107837	30.44806498	2729.35608	60000.00000
3.344561E+08	9.226374E+12	0.00003625	0.00109779	30.28375357	2758.90365	60000.00000
3.361933E+08	9.065887E+12	0.00003708	0.00111678	30.11552793	2787.13879	60000.00000
3.378986E+08	8.911611E+12	0.00003792	0.00113576	29.95411187	2814.70462	60000.00000
3.395986E+08	8.763835E+12	0.00003875	0.00115477	29.80043381	2841.68159	60000.00000
3.410842E+08	8.616863E+12	0.00003958	0.00117336	29.64275891	2867.42591	60000.00000
3.425468E+08	8.475384E+12	0.00004042	0.00119194	29.49135464	2892.54946	60000.00000
3.440045E+08	8.339502E+12	0.00004125	0.00121055	29.34677964	2917.10627	60000.00000
3.453646E+08	8.206683E+12	0.00004208	0.00122898	29.20355004	2940.80774	60000.00000
3.466128E+08	8.076414E+12	0.00004292	0.00124719	29.06078070	2963.62760	60000.00000
3.478564E+08	7.951003E+12	0.00004375	0.00126543	28.92408925	2985.90138	60000.00000
3.490955E+08	7.830178E+12	0.00004458	0.00128369	28.79314131	3007.62660	60000.00000
3.502570E+08	7.712081E+12	0.00004542	0.00130180	28.66357809	3028.57976	60000.00000
3.506722E+08	7.582101E+12	0.00004625	0.00132275	28.59999830	3052.26388	60000.00000
3.526325E+08	7.489539E+12	0.00004708	0.00134318	28.52766949	3074.58539	60000.00000
3.536482E+08	7.380485E+12	0.00004792	0.00136049	28.39274830	3092.76550	60000.00000
3.546602E+08	7.275081E+12	0.00004875	0.00137782	28.26298445	3110.45125	60000.00000
3.555833E+08	7.171429E+12	0.00004958	0.00139492	28.13280362	3127.36882	60000.00000
3.572817E+08	6.971350E+12	0.00005125	0.00142876	27.87832314	3159.33829	60000.00000
3.589660E+08	6.783609E+12	0.00005292	0.00146271	27.64178127	3189.40607	60000.00000
3.605100E+08	6.604763E+12	0.00005458	0.00149633	27.41359109	3217.18780	60000.00000
3.619065E+08	6.433893E+12	0.00005625	0.00152958	27.19245046	3242.72053	60000.00000
3.632898E+08	6.272629E+12	0.00005792	0.00156292	26.98574334	3266.40488	60000.00000
3.646301E+08	6.119666E+12	0.00005958	0.00159626	26.79034621	3288.14756	60000.00000
3.657706E+08	5.971764E+12	0.00006125	0.00162897	26.59535033	3307.58501	60000.00000
3.668986E+08	5.831501E+12	0.00006292	0.00166177	26.41222304	3325.22083	60000.00000
3.683458E+08	5.703419E+12	0.00006458	0.00170424	26.38820261	3345.53088	60000.00000
3.693951E+08	5.575775E+12	0.00006625	0.00173585	26.20158201	3358.37736	60000.00000

3.702605E+08	5.451689E+12	0.00006792	0.00176669	26.01267189	3369.23024	60000.00000
3.711042E+08	5.333234E+12	0.00006958	0.00179757	25.83327788	3378.45625	60000.00000
3.719375E+08	5.220176E+12	0.00007125	0.00182853	25.66355735	3386.06356	60000.00000
3.727603E+08	5.112142E+12	0.00007292	0.00185958	25.50286120	3392.03686	60000.00000
3.735690E+08	5.008747E+12	0.00007458	0.00189071	25.35032791	3396.35813	60000.00000
3.742233E+08	4.907847E+12	0.00007625	0.00192109	25.19463569	3398.96330	60000.00000
3.748678E+08	4.811137E+12	0.00007792	0.00195156	25.04676408	3399.98441	60000.00000
3.754819E+08	4.718097E+12	0.00007958	0.00198212	24.90622920	3393.47093	60000.00000
3.760877E+08	4.628772E+12	0.00008125	0.00201277	24.77259833	3385.85592	60000.00000
3.766889E+08	4.542982E+12	0.00008292	0.00204352	24.64547020	3390.28101	60000.00000
3.772852E+08	4.460514E+12	0.00008458	0.00207436	24.52446717	3394.58368	60000.00000
3.777768E+08	4.380021E+12	0.00008625	0.00210460	24.40119034	3397.57963	60000.00000
3.782499E+08	4.302369E+12	0.00008792	0.00213484	24.28250831	3399.38470	60000.00000
3.782499E+08	4.222325E+12	0.00008958	0.00216792	24.19999856	3399.35998	60000.00000
3.785457E+08	4.148446E+12	0.00009125	0.00220825	24.19999856	3390.15594	60000.00000
3.799668E+08	4.089329E+12	0.00009292	0.00224281	24.13785464	3382.47763	60000.00000
3.803819E+08	4.021659E+12	0.00009458	0.00227198	24.02094680	3386.43806	60000.00000
3.807947E+08	3.956308E+12	0.00009625	0.00230122	23.90880686	3390.65692	60000.00000
3.812051E+08	3.893158E+12	0.00009792	0.00233053	23.80120665	3394.10273	60000.00000
3.815485E+08	3.831449E+12	0.00009958	0.00235927	23.69145066	3396.69455	60000.00000
3.818629E+08	3.771485E+12	0.00010125	0.00238781	23.58331937	3398.52615	60000.00000
3.821752E+08	3.713443E+12	0.00010292	0.00241642	23.47933835	3399.63052	60000.00000
3.824854E+08	3.657231E+12	0.00010458	0.00244509	23.37932271	3399.99740	60000.00000
3.827868E+08	3.602699E+12	0.00010625	0.00247398	23.28455490	3394.78418	60000.00000
3.830870E+08	3.549841E+12	0.00010792	0.00250293	23.19314665	3389.55864	60000.00000
3.833650E+08	3.498388E+12	0.00010958	0.00253235	23.10890204	3384.20618	60000.00000
3.836295E+08	3.448355E+12	0.00011125	0.00256208	23.02995247	3378.77226	60000.00000
3.838801E+08	3.399676E+12	0.00011292	0.00259213	22.95616418	3378.93161	60000.00000
3.841291E+08	3.352399E+12	0.00011458	0.00262224	22.88501555	3383.58659	60000.00000
3.843353E+08	3.306110E+12	0.00011625	0.00265216	22.81430358	3387.62034	60000.00000
3.846572E+08	3.216645E+12	0.00011958	0.00271194	22.67823368	3393.97390	60000.00000
3.849731E+08	3.131985E+12	0.00012292	0.00277195	22.55147141	3398.08523	60000.00000
3.852586E+08	3.051553E+12	0.00012625	0.00283283	22.43823391	3399.91839	60000.00000
3.855131E+08	2.975021E+12	0.00012958	0.00289462	22.33791929	3392.87606	60000.00000
3.857602E+08	2.902271E+12	0.00013292	0.00295670	22.24478406	3383.25441	60000.00000
3.860036E+08	2.833054E+12	0.00013625	0.00301896	22.15749854	3373.58622	60000.00000
3.862154E+08	2.766917E+12	0.00013958	0.00308218	22.08129877	3372.04150	60000.00000
3.863390E+08	2.703247E+12	0.00014292	0.00314428	22.00082678	3380.81542	60000.00000
3.878648E+08	2.652067E+12	0.00014625	0.00321750	22.00000066	3390.22842	60000.00000
3.893390E+08	2.602824E+12	0.00014958	0.00329083	22.00000066	3396.50984	60000.00000
3.907463E+08	2.555289E+12	0.00015292	0.00336417	22.00000066	3399.62741	60000.00000
3.918816E+08	2.508043E+12	0.00015625	0.00343750	22.00000066	3394.51569	60000.00000
3.918816E+08	2.455655E+12	0.00015958	0.00350985	21.99381262	3384.11931	60000.00000
3.918816E+08	2.405412E+12	0.00016292	0.00357301	21.93154281	3376.14802	60000.00000
3.918816E+08	2.357183E+12	0.00016625	0.00363634	21.87275058	3368.13365	60000.00000
3.918816E+08	2.310850E+12	0.00016958	0.00369984	21.81725496	3360.07514	60000.00000
3.918816E+08	2.266304E+12	0.00017292	0.00376351	21.76489466	3361.62745	60000.00000
3.918816E+08	2.223442E+12	0.00017625	0.00382736	21.71552414	3370.17444	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 385929.47495 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number          =          1
Depth below pile head      =     60.000 in
Depth below ground surface =     48.000 in
Equivalent Depth (see note) =    48.000 in
Pile Diameter              =    132.000 in
Angle of Friction          =     46.000 deg.
Avg. Eff. Unit Weight      =    0.05300 pci
k                          =    225.000 pci
A (static)                 =     2.5755
B (static)                 =     1.9145
Pst                        =   2979.144 lbs/in
Psd                        =  82368.160 lbs/in
Ps                         =   2979.144 lbs/in
Cbar                       =  4587.6751
n                          =     3.6210
m                          =   715.9795
yk                         =     0.3064 in
pm                         =   5703.707 lbs/in
ym                         =     2.2000 in
pu                         =   7672.651 lbs/in
yu                         =     4.9500 in
p-multiplier               =    1.00000
y-multiplier               =    1.00000
```

This p-y curve is computed using the equivalent depth.

```
        y, in              p, lbs/in
----------------    ----------------
          0.0000           0.0000
       0.1833333        1980.0000   *
       0.3666667        3477.4460
       0.5500000        3889.4693
       0.7333333        4211.0834
       0.9166667        4478.7502
          1.1000        4710.0313
          1.2833        4914.8701
          1.4667        5099.4965
          1.6500        5268.0968
          1.8333        5423.6329
          2.0167        5568.2847
          2.2000        5703.7075
          3.5750        6688.1793
          4.9500        7672.6512
        136.9500        7672.6512
        268.9500        7672.6512

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.



p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number           =          3
Depth below pile head       =      174.000 in
Depth below ground surface =      162.000 in
Equivalent Depth            =      113.426 in
Diameter                    =      132.000 in
Undrained cohesion, c       =     55.55000 lbs/in**2
Average Eff. Unit Weight    =      0.06404 lbs/in**3
Epsilon-50                  =      0.00400
Pct                         =    26106.972 lbs/in
Pcd                         =    65993.400 lbs/in
Pu                          =    26106.972 lbs/in
y50                         =        1.320 in
p-multiplier                =      1.00000
y-multiplier                =      1.00000

        y, in              p, lbs/in
----------------    ----------------
          0.0000           0.0000
       0.0002112        1468.1029
       0.0010560        2195.3259
       0.0021120        2610.6972
       0.0105600        3903.9029
       0.0211200        4642.5491
       0.1056000        6942.2300
       0.2112000        8255.7493
       0.5280000       10381.0552
          1.0560       12345.2247
          1.5840       13662.2371
          2.1120       14681.0291
          5.2800       18460.4167
         10.5600       21953.2589
         21.1200       26106.9717
         23.7600       26106.9717
         26.4000       26106.9717



p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number           =          4
Depth below pile head       =      348.000 in
Depth below ground surface =      336.000 in
Equivalent Depth            =      285.366 in
Diameter                    =      132.000 in
Undrained cohesion, c       =     55.55000 lbs/in**2
Average Eff. Unit Weight    =      0.06616 lbs/in**3
Epsilon-50                  =      0.00400
```

Pct	=	32415.991 lbs/in
Pcd	=	65993.400 lbs/in
Pu	=	32415.991 lbs/in
y50	=	1.320 in
p-multiplier	=	1.00000
y-multiplier	=	1.00000

y, in	p, lbs/in
0.0000	0.0000
0.0002112	1822.8851
0.0010560	2725.8490
0.0021120	3241.5990
0.0105600	4847.3213
0.0211200	5764.4689
0.1056000	8619.8915
0.2112000	10250.8363
0.5280000	12889.7443
1.0560	15328.5756
1.5840	16963.8576
2.1120	18228.8512
5.2800	22921.5668
10.5600	27258.4903
21.1200	32415.9907
23.7600	32415.9907
26.4000	32415.9907

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 319693.000 lbs
Specified moment at pile head = 345051000.000 in-lbs
Specified axial load at pile head = 189766.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	5.961	3.45E+08	3.20E+05	-0.030203	1542.001	8.11E+12	0.000	0.000
3.840	5.845	3.46E+08	3.20E+05	-0.030039	1547.535	8.11E+12	0.000	0.000
7.680	5.730	3.48E+08	3.20E+05	-0.029875	1553.069	8.11E+12	0.000	0.000
11.520	5.616	3.49E+08	3.20E+05	-0.029707	1558.602	7.86E+12	0.000	0.000
15.360	5.502	3.50E+08	3.20E+05	-0.029535	1564.134	7.73E+12	-45.655	31.863
19.200	5.389	3.51E+08	3.19E+05	-0.029359	1569.663	7.55E+12	-215.974	153.893
23.040	5.277	3.53E+08	3.18E+05	-0.029179	1575.177	7.49E+12	-522.406	380.170
26.880	5.165	3.54E+08	3.15E+05	-0.028997	1580.657	7.37E+12	-975.102	724.958
30.720	5.054	3.55E+08	3.10E+05	-0.028810	1586.072	7.24E+12	-1583.826	1203.385
34.560	4.944	3.56E+08	3.02E+05	-0.028620	1591.383	7.10E+12	-2356.604	1830.476
38.400	4.834	3.57E+08	2.92E+05	-0.028425	1596.540	6.96E+12	-3271.558	2598.737
42.240	4.725	3.58E+08	2.77E+05	-0.028226	1601.482	6.84E+12	-4312.229	3504.234
46.080	4.617	3.60E+08	2.59E+05	-0.028022	1606.142	6.72E+12	-4915.956	4088.276
49.920	4.510	3.61E+08	2.39E+05	-0.027815	1610.480	6.60E+12	-5527.419	4706.058
53.760	4.404	3.61E+08	2.17E+05	-0.027603	1614.457	6.49E+12	-6145.205	5358.460
57.600	4.298	3.62E+08	1.92E+05	-0.027387	1618.032	6.40E+12	-6767.931	6046.429
61.440	4.193	3.63E+08	1.65E+05	-0.027168	1621.164	6.31E+12	-7394.244	6770.986
65.280	4.090	3.64E+08	1.35E+05	-0.026946	1623.813	6.25E+12	-8022.819	7533.231
69.120	3.987	3.64E+08	1.03E+05	-0.026721	1625.936	6.19E+12	-8652.359	8334.353
72.960	3.884	3.64E+08	58328.	-0.026495	1627.494	6.15E+12	-14709.	14541.
76.800	3.783	3.64E+08	1860.825	-0.026267	1628.091	6.14E+12	-14701.	14922.
80.640	3.683	3.64E+08	-54572.	-0.026039	1627.727	6.14E+12	-14691.	15319.
84.480	3.583	3.64E+08	-1.11E+05	-0.025812	1626.403	6.18E+12	-14679.	15732.
88.320	3.484	3.64E+08	-1.67E+05	-0.025587	1624.120	6.24E+12	-14665.	16162.
92.160	3.387	3.63E+08	-2.24E+05	-0.025365	1620.878	6.32E+12	-14649.	16611.
96.000	3.290	3.62E+08	-2.80E+05	-0.025147	1616.679	6.43E+12	-14631.	17079.
99.840	3.193	3.61E+08	-3.36E+05	-0.024933	1611.523	6.58E+12	-14610.	17568.
103.680	3.098	3.59E+08	-3.92E+05	-0.024726	1605.413	6.74E+12	-14586.	18079.
107.520	3.004	3.58E+08	-4.48E+05	-0.024524	1598.350	6.92E+12	-14560.	18614.
111.360	2.910	3.56E+08	-5.04E+05	-0.024329	1590.335	7.13E+12	-14530.	19176.
115.200	2.817	3.54E+08	-5.60E+05	-0.024140	1581.371	7.35E+12	-14498.	19765.
119.040	2.724	3.52E+08	-6.15E+05	-0.023958	1571.460	7.53E+12	-14462.	20384.
122.880	2.633	3.49E+08	-6.71E+05	-0.023783	1560.603	7.81E+12	-14423.	21037.
126.720	2.542	3.47E+08	-7.26E+05	-0.023614	1548.804	8.08E+12	-14380.	21725.
130.560	2.451	3.44E+08	-7.81E+05	-0.023453	1536.065	8.37E+12	-14333.	22452.
134.400	2.362	3.41E+08	-8.36E+05	-0.023299	1522.390	8.66E+12	-14262.	23190.

138.240	2.272	3.37E+08	-8.91E+05	-0.023151	1507.783	8.96E+12	-14205.	24005.
142.080	2.184	3.34E+08	-9.45E+05	-0.023010	1492.248	9.28E+12	-14144.	24871.
145.920	2.096	3.30E+08	-9.99E+05	-0.022875	1475.789	9.59E+12	-14078.	25795.
149.760	2.008	3.26E+08	-1.05E+06	-0.022745	1458.410	9.88E+12	-14006.	26783.
153.600	1.921	3.22E+08	-1.11E+06	-0.022621	1440.116	1.02E+13	-13928.	27842.
157.440	1.834	3.18E+08	-1.16E+06	-0.022502	1420.912	1.05E+13	-13845.	28982.
161.280	1.748	3.13E+08	-1.21E+06	-0.022388	1400.804	1.08E+13	-13754.	30212.
165.120	1.662	3.08E+08	-1.27E+06	-0.022279	1379.797	1.11E+13	-13657.	31545.
168.960	1.577	3.03E+08	-1.32E+06	-0.022174	1357.898	1.13E+13	-13551.	32995.
172.800	1.492	2.98E+08	-1.37E+06	-0.022073	1335.113	1.16E+13	-13437.	34580.
176.640	1.408	2.93E+08	-1.42E+06	-0.021976	1311.451	1.18E+13	-13314.	36321.
180.480	1.323	2.87E+08	-1.47E+06	-0.021882	1236.919	1.20E+13	-13180.	38245.
184.320	1.240	2.82E+08	-1.52E+06	-0.021791	1261.526	1.21E+13	-13035.	40383.
188.160	1.156	2.76E+08	-1.57E+06	-0.021704	1235.281	1.23E+13	-12878.	42777.
192.000	1.073	2.70E+08	-1.62E+06	-0.021618	1208.195	1.23E+13	-12706.	45479.
195.840	0.989973	2.63E+08	-1.67E+06	-0.021535	1180.279	1.24E+13	-12519.	48558.
199.680	0.907434	2.57E+08	-1.72E+06	-0.021455	1151.546	1.24E+13	-12313.	52105.
203.520	0.825201	2.50E+08	-1.76E+06	-0.021376	1122.008	1.24E+13	-12086.	56243.
207.360	0.743267	2.43E+08	-1.81E+06	-0.021299	1091.680	1.24E+13	-11835.	61145.
211.200	0.661622	2.36E+08	-1.85E+06	-0.021225	1060.579	1.24E+13	-11555.	67064.
215.040	0.580258	2.29E+08	-1.90E+06	-0.021153	1028.724	1.24E+13	-11239.	74378.
218.880	0.499167	2.22E+08	-1.94E+06	-0.021083	996.134	1.24E+13	-10879.	83691.
222.720	0.418340	2.14E+08	-1.98E+06	-0.021016	962.834	1.24E+13	-10462.	96030.
226.560	0.337766	2.07E+08	-2.02E+06	-0.020951	928.850	1.24E+13	-9966.826	1.13E+05
230.400	0.257438	1.99E+08	-2.06E+06	-0.020888	894.215	1.24E+13	-9359.237	1.40E+05
234.240	0.177345	1.91E+08	-2.09E+06	-0.020828	858.969	1.25E+13	-8569.112	1.86E+05
238.080	0.097478	1.83E+08	-2.12E+06	-0.020771	823.163	1.25E+13	-7414.908	2.92E+05
241.920	0.017828	1.75E+08	-2.15E+06	-0.020715	786.872	1.25E+13	-4872.858	1.05E+06
245.760	-0.061617	1.66E+08	-2.14E+06	-0.020663	750.264	1.25E+13	6676.865	4.16E+05
249.600	-0.140865	1.58E+08	-2.12E+06	-0.020613	714.091	1.25E+13	8250.201	2.25E+05
253.440	-0.219926	1.50E+08	-2.08E+06	-0.020566	678.456	1.25E+13	9267.017	1.62E+05
257.280	-0.298810	1.42E+08	-2.04E+06	-0.020521	643.427	1.25E+13	10053.	1.29E+05
261.120	-0.377527	1.34E+08	-2.00E+06	-0.020479	609.054	1.25E+13	10710.	1.09E+05
264.960	-0.456086	1.27E+08	-1.96E+06	-0.020439	575.380	1.25E+13	11282.	94990.
268.800	-0.534496	1.19E+08	-1.92E+06	-0.020415	542.443	5.94E+13	11795.	84737.
272.640	-0.612876	1.12E+08	-1.87E+06	-0.020408	510.276	5.95E+13	12263.	76835.
276.480	-0.691228	1.05E+08	-1.82E+06	-0.020401	478.910	5.95E+13	12697.	70538.
280.320	-0.769554	9.81E+07	-1.77E+06	-0.020394	448.374	5.96E+13	13104.	65388.
284.160	-0.847856	9.14E+07	-1.72E+06	-0.020388	418.692	5.97E+13	13455.	60938.
288.000	-0.926135	8.49E+07	-1.67E+06	-0.020382	389.890	5.98E+13	13820.	57302.
291.840	-1.004	7.86E+07	-1.62E+06	-0.020377	361.990	5.98E+13	14169.	54173.
295.680	-1.083	7.25E+07	-1.56E+06	-0.020372	335.015	5.99E+13	14505.	51448.
299.520	-1.161	6.66E+07	-1.51E+06	-0.020368	308.988	6.00E+13	14829.	49053.
303.360	-1.239	6.10E+07	-1.45E+06	-0.020364	283.929	6.00E+13	15142.	46928.
307.200	-1.317	5.55E+07	-1.39E+06	-0.020360	259.858	6.01E+13	15447.	45029.
311.040	-1.395	5.03E+07	-1.33E+06	-0.020357	236.797	6.02E+13	15743.	43322.
314.880	-1.474	4.54E+07	-1.27E+06	-0.020354	214.764	6.02E+13	16032.	41776.
318.720	-1.552	4.06E+07	-1.21E+06	-0.020351	193.777	6.02E+13	16314.	40371.
322.560	-1.630	3.61E+07	-1.14E+06	-0.020349	173.856	6.03E+13	16590.	39086.
326.400	-1.708	3.19E+07	-1.08E+06	-0.020346	155.018	6.03E+13	16861.	37908.
330.240	-1.786	2.79E+07	-1.01E+06	-0.020344	137.281	6.04E+13	17127.	36821.
334.080	-1.864	2.41E+07	-9.48E+05	-0.020343	120.663	6.04E+13	17389.	35817.
337.920	-1.942	2.06E+07	-8.80E+05	-0.020341	105.180	6.04E+13	17646.	34886.
341.760	-2.020	1.74E+07	-8.12E+05	-0.020340	90.850	6.04E+13	17900.	34019.
345.600	-2.099	1.44E+07	-7.43E+05	-0.020339	77.689	6.04E+13	18150.	33211.
349.440	-2.177	1.17E+07	-6.73E+05	-0.020338	65.713	6.04E+13	18397.	32455.
353.280	-2.255	9.27E+06	-6.02E+05	-0.020338	54.938	6.04E+13	18641.	31746.
357.120	-2.333	7.12E+06	-5.30E+05	-0.020337	45.380	6.04E+13	18882.	31080.
360.960	-2.411	5.24E+06	-4.57E+05	-0.020337	37.056	6.04E+13	19121.	30454.
364.800	-2.489	3.64E+06	-3.83E+05	-0.020336	29.981	6.04E+13	19357.	29862.
368.640	-2.567	2.33E+06	-3.08E+05	-0.020336	24.169	6.04E+13	19591.	29304.
372.480	-2.645	1.30E+06	-2.32E+05	-0.020336	19.637	6.04E+13	19822.	28775.
376.320	-2.723	5.72E+05	-1.56E+05	-0.020336	16.399	6.04E+13	20052.	28274.
380.160	-2.801	1.36E+05	-78309.	-0.020336	14.471	6.04E+13	20280.	27798.
384.000	-2.880	0.000	0.000	-0.020336	13.867	6.04E+13	20506.	13673.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 5.96100940 in
Computed slope at pile head = -0.03020272

```
Maximum bending moment          =   3.644900E+08 lbs-in
Maximum shear force             =     -2147236. lbs
Depth of maximum bending moment =    76.80000000 in
Depth of maximum shear force    =      241.92000 in
Number of iterations            =             68
Number of zero deflection points =             1
```

```
-------------------------------------------------------------------------------
                          Summary of Pile Response(s)
-------------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head     Pile-Head       Axial     Pile-Head    Maximum     Maximum
Type  Condition     Condition       Load      Deflection   Moment      Shear
          1             2           lbs          in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  3.20E+05 M=  3.45E+08     189766.      5.9610  3.6449E+08   -2147236.
```

```
--------------------------------------------------------------------------------
                      Pile-head Deflection vs. Pile Length
--------------------------------------------------------------------------------

Boundary Condition Type 1, Shear and Moment

Shear      =        319693. lbs
Moment     =     345051000. in-lbs
Axial Load =        189766. lbs


   Pile       Pile Head       Maximum       Maximum
  Length      Deflection      Moment         Shear
    in           in           in-lbs          lbs
-----------  ------------  ------------  ------------
   384.000    5.96100940  3.644900E+08     -2147236.
   364.800    9.67669418  3.645079E+08     -2284333.
   345.600   17.24274584  3.649851E+08     -2455670.
   326.400   35.83867125  3.663930E+08     -2688756.

The analysis ended normally.
```

B.15 Drained Analysis from BPT (Service)

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.47)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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                            All Rights Reserved

================================================================================

This program is licensed to:

Zach McClellan
University Of Utah

--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------
```

```
Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using Becker Friction Angles.lpd
Name of output file:         Drilled Shaft Analysis Using Becker Friction Angles.lpo
Name of plot output file:    Drilled Shaft Analysis Using Becker Friction Angles.lpp
Name of runtime file:        Drilled Shaft Analysis Using Becker Friction Angles.lpr

--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  October 11, 2012     Time:  12:35:06

--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Drilled Shaft Analysis Using Becker Friction Angles


--------------------------------------------------------------------------------
                                Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments            =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


--------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                              =     336.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface            =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
          in            in         in**4        Sq.in      lbs/Sq.in
-----  ----------  -----------  ----------   ----------   -----------
  1       0.0000    132.00000    14902723.   13685.0000      3604997.
  2     336.0000    132.00000    14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.
--------------------------------------------------------------------------------
```

```
                      Soil and Rock Layering Information
-------------------------------------------------------------------------------

The soil profile is modelled using  5 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       12.000 in
Distance from top of pile to bottom of layer =       72.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       72.000 in
Distance from top of pile to bottom of layer =      132.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      132.000 in
Distance from top of pile to bottom of layer =      282.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      700.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.


(Depth of lowest layer extends  364.00 in below pile tip)


-------------------------------------------------------------------------------
                 Effective Unit Weight of Soil vs. Depth
-------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 10 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------    ----------------
  1           12.00        0.05300
  2           72.00        0.05300
  3           72.00        0.07300
  4          132.00        0.07300
  5          132.00        0.06700
  6          282.00        0.06700
  7          282.00        0.07000
  8          396.00        0.07000
  9          396.00        0.06900
 10          700.00        0.06900



-------------------------------------------------------------------------------
                         Shear Strength of Soils
-------------------------------------------------------------------------------

Shear strength parameters with depth defined using 10 points
```

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	46.00	------	------
2	72.000	0.00000	46.00	------	------
3	72.000	0.00000	47.00	------	------
4	132.000	0.00000	47.00	------	------
5	132.000	0.00000	48.00	------	------
6	282.000	0.00000	48.00	------	------
7	282.000	0.00000	48.00	------	------
8	396.000	0.00000	48.00	------	------
9	396.000	0.00000	48.00	------	------
10	700.000	0.00000	48.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 4 points

Point No.	Depth X in	p-mult	y-mult
1	12.000	1.0000	1.0000
2	42.000	1.0000	1.0000
3	42.001	1.0000	1.0000
4	700.000	1.0000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 221503.000 lbs
Bending moment at pile head = 235128000.000 in-lbs
Axial load at pile head = 117367.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Output of p-y Curves at Specified Depths

p-y curves are generated and printed for verification at 2 depths.

Depth No.	Depth Below Pile Head in	Depth Below Ground Surface in
1	60.000	48.000

```
  2              180.000                   168.000

Depth of ground surface below top of pile =      12.00 in


-----------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
-----------------------------------------------------------------------------

Number of sections =  1



Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                         =      132.0000 in

Material Properties:

Compressive Strength of Concrete         =         4.000 kip/in**2
Yield Stress of Reinforcement            =           60. kip/in**2
Modulus of Elasticity of Reinforcement   =        29000. kip/in**2
Number of Reinforcing Bars               =           100
Area of Single Bar                       =       1.27000 in**2
Number of Rows of Reinforcing Bars       =            51
Area of Steel                            =       127.000 in**2
Area of Shaft                            =     13684.778 in**2
Percentage of Steel Reinforcement        =         0.928 percent
Cover Thickness (edge to bar center)     =         4.000 in

Unfactored Axial Squash Load Capacity    =      53716.45 kip

Distribution and Area of Steel Reinforcement
```

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.270	62.000
2	2.540	61.878
3	2.540	61.511
4	2.540	60.902
5	2.540	60.052
6	2.540	58.966
7	2.540	57.646
8	2.540	56.099
9	2.540	54.331
10	2.540	52.348
11	2.540	50.159
12	2.540	47.772
13	2.540	45.196
14	2.540	42.442
15	2.540	39.520
16	2.540	36.443
17	2.540	33.221
18	2.540	29.869
19	2.540	26.398
20	2.540	22.824
21	2.540	19.159
22	2.540	15.419
23	2.540	11.618
24	2.540	7.771
25	2.540	3.893
26	2.540	0.000
27	2.540	-3.893
28	2.540	-7.771
29	2.540	-11.618
30	2.540	-15.419
31	2.540	-19.159
32	2.540	-22.824
33	2.540	-26.398
34	2.540	-29.869
35	2.540	-33.221
36	2.540	-36.443
37	2.540	-39.520
38	2.540	-42.442
39	2.540	-45.196
40	2.540	-47.772

41	2.540	-50.159
42	2.540	-52.348
43	2.540	-54.331
44	2.540	-56.099
45	2.540	-57.646
46	2.540	-58.966
47	2.540	-60.052
48	2.540	-60.902
49	2.540	-61.511
50	2.540	-61.878
51	1.270	-62.000

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25476354.	6.114325E+13	4.166667E-07	0.00002759	66.21587902	97.95153255	751.77520
50726322.	6.087159E+13	8.333333E-07	0.00005518	66.21542269	194.47007	1503.53938
75749906.	6.059992E+13	0.00000125	0.00008277	66.21496242	289.55565	2255.29239
1.005471E+08	6.032826E+13	0.00000167	0.00011036	66.21449822	383.20832	3007.03408
1.251179E+08	6.005660E+13	0.00000208	0.00013795	66.21403009	475.42813	3758.76432
1.251179E+08	5.004717E+13	0.00000250	0.00008208	32.83139080	282.36798	6899.72417
1.251179E+08	4.289757E+13	0.00000292	0.00009582	32.85245293	328.45176	8047.89669
1.251179E+08	3.753538E+13	0.00000333	0.00010958	32.87361342	374.25373	9195.55070
1.251179E+08	3.336478E+13	0.00000375	0.00012336	32.89486831	419.77288	10342.68307
1.251179E+08	3.002830E+13	0.00000417	0.00013715	32.91622549	465.00833	11489.28942
1.251179E+08	2.729846E+13	0.00000458	0.00015096	32.93768102	509.95903	12635.36656
1.251179E+08	2.502358E+13	0.00000500	0.00016480	32.95923489	554.62396	13780.91094
1.251179E+08	2.309869E+13	0.00000542	0.00017865	32.98088712	599.00210	14925.91898
1.251179E+08	2.144879E+13	0.00000583	0.00019250	33.00000197	643.04206	16070.83300
1.251179E+08	2.001887E+13	0.00000625	0.00020625	33.00000197	686.39668	17218.74964
1.251179E+08	1.876769E+13	0.00000667	0.00022000	33.00000197	729.40771	18366.66629
1.251179E+08	1.766371E+13	0.00000708	0.00023375	33.00000197	772.07514	19514.58293
1.251179E+08	1.668239E+13	0.00000750	0.00024755	33.00632769	814.54943	20661.12373
1.251179E+08	1.580437E+13	0.00000792	0.00026146	33.02685088	857.04776	21804.25215
1.251179E+08	1.501415E+13	0.00000833	0.00027540	33.04746455	899.24960	22946.86273
1.251179E+08	1.429919E+13	0.00000875	0.00028935	33.06817263	941.15399	24088.95119
1.253194E+08	1.367120E+13	0.00000917	0.00030332	33.08897513	982.75989	25230.51411
1.309487E+08	1.366421E+13	0.00000958	0.00031730	33.10987204	1024.06623	26371.54806
1.365720E+08	1.365720E+13	0.00001000	0.00033131	33.13086337	1065.07192	27512.04962
1.421891E+08	1.365015E+13	0.00001042	0.00034533	33.15195304	1105.77599	28652.01419
1.478001E+08	1.364308E+13	0.00001083	0.00035938	33.17314106	1146.17733	29791.43818
1.534049E+08	1.363599E+13	0.00001125	0.00037344	33.19442743	1186.27483	30930.31805
1.590035E+08	1.362887E+13	0.00001167	0.00038752	33.21581608	1226.06748	32068.64889
1.645958E+08	1.362172E+13	0.00001208	0.00040162	33.23730308	1265.55403	33206.42838
1.701818E+08	1.361454E+13	0.00001250	0.00041574	33.25889236	1304.73343	34343.65152
1.757615E+08	1.360734E+13	0.00001292	0.00042987	33.28058392	1343.60454	35480.31461
1.813348E+08	1.360011E+13	0.00001333	0.00044403	33.30237776	1382.16615	36616.41393
1.869017E+08	1.359285E+13	0.00001375	0.00045821	33.32427782	1420.41723	37751.94422
1.924622E+08	1.358556E+13	0.00001417	0.00047241	33.34628409	1458.35657	38886.90162
1.980161E+08	1.357825E+13	0.00001458	0.00048662	33.36839265	1495.98280	40021.28394
2.035636E+08	1.357091E+13	0.00001500	0.00050086	33.39061528	1533.29513	41155.08235
2.091045E+08	1.356353E+13	0.00001542	0.00051512	33.41294414	1570.29200	42288.29622
2.146388E+08	1.355613E+13	0.00001583	0.00052939	33.43538314	1606.97232	43420.91991
2.201664E+08	1.354870E+13	0.00001625	0.00054369	33.45793229	1643.33480	44552.94941
2.312016E+08	1.353375E+13	0.00001708	0.00057235	33.50336891	1715.10137	46815.20598
2.422097E+08	1.351868E+13	0.00001792	0.00060109	33.54926187	1785.58150	49075.02935
2.531904E+08	1.350349E+13	0.00001875	0.00062992	33.59562689	1854.76509	51332.37788
2.641432E+08	1.348817E+13	0.00001958	0.00065883	33.64246398	1922.64107	53587.21733
2.750680E+08	1.347272E+13	0.00002042	0.00068783	33.68978888	1989.19882	55839.50417
2.859642E+08	1.345714E+13	0.00002125	0.00071692	33.73761338	2054.42728	58089.19575
2.967232E+08	1.343652E+13	0.00002208	0.00074601	33.78144497	2118.09301	60000.00000
3.052926E+08	1.332186E+13	0.00002292	0.00077317	33.73828608	2176.02906	60000.00000
3.124730E+08	1.315676E+13	0.00002375	0.00079909	33.64578027	2229.97326	60000.00000
3.187410E+08	1.296574E+13	0.00002458	0.00082417	33.52554435	2280.95855	60000.00000
3.243247E+08	1.276031E+13	0.00002542	0.00084861	33.38796383	2329.50000	60000.00000
3.293689E+08	1.254739E+13	0.00002625	0.00087253	33.23941952	2375.93339	60000.00000
3.339510E+08	1.233050E+13	0.00002708	0.00089600	33.08319622	2420.44829	60000.00000
3.390265E+08	1.214423E+13	0.00002792	0.00092125	33.00000197	2467.36427	60000.00000
3.421665E+08	1.190144E+13	0.00002875	0.00094422	32.84229559	2508.88759	60000.00000
3.457708E+08	1.168803E+13	0.00002958	0.00096634	32.66486853	2547.92546	60000.00000
3.490333E+08	1.147507E+13	0.00003042	0.00098803	32.48322433	2585.33441	60000.00000
3.521400E+08	1.126848E+13	0.00003125	0.00100955	32.30569893	2621.60086	60000.00000
3.550246E+08	1.106570E+13	0.00003208	0.00103080	32.12880296	2656.57286	60000.00000
3.577186E+08	1.086740E+13	0.00003292	0.00105180	31.95342547	2690.33435	60000.00000
3.602788E+08	1.067493E+13	0.00003375	0.00107264	31.78199762	2723.05334	60000.00000
3.626651E+08	1.048670E+13	0.00003458	0.00109325	31.61198598	2754.62514	60000.00000
3.649275E+08	1.030384E+13	0.00003542	0.00111370	31.44555420	2785.20094	60000.00000

3.671024E+08	1.012696E+13	0.00003625	0.00113404	31.28386277	2814.87554	60000.00000
3.690935E+08	9.953084E+12	0.00003708	0.00115411	31.12201399	2843.41113	60000.00000
3.710781E+08	9.786676E+12	0.00003792	0.00117421	30.96817070	2871.28187	60000.00000
3.728888E+08	9.622938E+12	0.00003875	0.00119403	30.81374913	2898.04725	60000.00000
3.748703E+08	9.470408E+12	0.00003958	0.00121808	30.77244705	2929.84195	60000.00000
3.765709E+08	9.317218E+12	0.00004042	0.00123730	30.61348969	2954.26711	60000.00000
3.781214E+08	9.166580E+12	0.00004125	0.00125623	30.45398551	2977.67239	60000.00000
3.795985E+08	9.020163E+12	0.00004208	0.00127504	30.29793924	3000.29647	60000.00000
3.810705E+08	8.879312E+12	0.00004292	0.00129388	30.14866322	3022.33472	60000.00000
3.824793E+08	8.742383E+12	0.00004375	0.00131261	30.00261301	3043.62131	60000.00000
3.837522E+08	8.607525E+12	0.00004458	0.00133107	29.85567766	3063.96715	60000.00000
3.850203E+08	8.477511E+12	0.00004542	0.00134955	29.71478087	3083.74758	60000.00000
3.862836E+08	8.352078E+12	0.00004625	0.00136806	29.57960004	3102.95979	60000.00000
3.874732E+08	8.229519E+12	0.00004708	0.00138642	29.44603604	3121.41473	60000.00000
3.885611E+08	8.109101E+12	0.00004792	0.00140456	29.31245631	3139.05286	60000.00000
3.896445E+08	7.992708E+12	0.00004875	0.00142272	29.18403000	3156.14208	60000.00000
3.907234E+08	7.880136E+12	0.00004958	0.00144092	29.06049746	3172.67950	60000.00000
3.927391E+08	7.663203E+12	0.00005125	0.00147703	28.82004136	3203.76888	60000.00000
3.928849E+08	7.424596E+12	0.00005292	0.00151342	28.59999830	3232.79798	60000.00000
3.966872E+08	7.267552E+12	0.00005458	0.00155510	28.49045867	3263.39404	60000.00000
3.982476E+08	7.079958E+12	0.00005625	0.00158917	28.25193018	3285.88009	60000.00000
3.997207E+08	6.901653E+12	0.00005792	0.00162309	28.02449924	3306.25345	60000.00000
4.011796E+08	6.733083E+12	0.00005958	0.00165711	27.81155688	3324.68210	60000.00000
4.024870E+08	6.571216E+12	0.00006125	0.00169069	27.60316998	3340.88958	60000.00000
4.037013E+08	6.416444E+12	0.00006292	0.00172407	27.40249747	3355.04838	60000.00000
4.049021E+08	6.269452E+12	0.00006458	0.00175756	27.21378404	3367.30862	60000.00000
4.060892E+08	6.129649E+12	0.00006625	0.00179114	27.03614062	3377.65146	60000.00000
4.070893E+08	5.993952E+12	0.00006792	0.00182407	26.85745865	3385.87838	60000.00000
4.080697E+08	5.864474E+12	0.00006958	0.00185707	26.68836755	3392.23773	60000.00000
4.090370E+08	5.740870E+12	0.00007125	0.00189016	26.52863127	3396.71998	60000.00000
4.104244E+08	5.628678E+12	0.00007292	0.00192500	26.40000039	3399.38858	60000.00000
4.112162E+08	5.513513E+12	0.00007458	0.00196794	26.38583833	3395.76365	60000.00000
4.119213E+08	5.402246E+12	0.00007625	0.00199909	26.21758908	3388.01797	60000.00000
4.126212E+08	5.295674E+12	0.00007792	0.00203034	26.05779773	3390.91516	60000.00000
4.133160E+08	5.193500E+12	0.00007958	0.00206168	25.90594894	3395.12405	60000.00000
4.140054E+08	5.095451E+12	0.00008125	0.00209313	25.76156670	3398.04262	60000.00000
4.146886E+08	5.001270E+12	0.00008292	0.00212467	25.62415141	3399.65551	60000.00000
4.152413E+08	4.909256E+12	0.00008458	0.00215552	25.48392731	3398.27690	60000.00000
4.157833E+08	4.820676E+12	0.00008625	0.00218654	25.35120910	3391.53208	60000.00000
4.163220E+08	4.735417E+12	0.00008792	0.00221764	25.22439176	3384.76707	60000.00000
4.168576E+08	4.653294E+12	0.00008958	0.00224882	25.10315663	3387.41726	60000.00000
4.173898E+08	4.574134E+12	0.00009125	0.00228008	24.98720866	3391.83006	60000.00000
4.179185E+08	4.497778E+12	0.00009292	0.00231142	24.87626857	3395.30434	60000.00000
4.184053E+08	4.423668E+12	0.00009458	0.00234253	24.76681942	3397.80157	60000.00000
4.188306E+08	4.351486E+12	0.00009625	0.00237325	24.65711850	3399.34294	60000.00000
4.192528E+08	4.281731E+12	0.00009792	0.00240404	24.55194157	3399.98156	60000.00000
4.196653E+08	4.214212E+12	0.00009958	0.00243503	24.45221704	3395.38769	60000.00000
4.200742E+08	4.148881E+12	0.00010125	0.00246611	24.35663098	3389.59867	60000.00000
4.204675E+08	4.085515E+12	0.00010292	0.00249746	24.26678056	3383.73787	60000.00000
4.204675E+08	4.020407E+12	0.00010458	0.00253092	24.19999856	3379.76754	60000.00000
4.204675E+08	3.957342E+12	0.00010625	0.00257125	24.19999856	3386.74680	60000.00000
4.208985E+08	3.900217E+12	0.00010792	0.00261158	24.19999856	3392.25526	60000.00000
4.220991E+08	3.851855E+12	0.00010958	0.00264902	24.17356664	3395.93695	60000.00000
4.223088E+08	3.796034E+12	0.00011125	0.00267986	24.08860606	3397.88513	60000.00000
4.225165E+08	3.741844E+12	0.00011292	0.00271076	24.00675720	3399.20670	60000.00000
4.227224E+08	3.689214E+12	0.00011458	0.00274174	23.92789811	3399.89447	60000.00000
4.229109E+08	3.637944E+12	0.00011625	0.00277318	23.85535294	3397.83583	60000.00000
4.232583E+08	3.539442E+12	0.00011958	0.00283693	23.72342151	3387.77541	60000.00000
4.236011E+08	3.446246E+12	0.00012292	0.00290087	23.60030991	3377.66094	60000.00000
4.239317E+08	3.357875E+12	0.00012625	0.00296524	23.48701340	3376.78559	60000.00000
4.241783E+08	3.273401E+12	0.00012958	0.00302982	23.38123852	3385.30625	60000.00000
4.243690E+08	3.192745E+12	0.00013292	0.00309369	23.27543217	3391.76040	60000.00000
4.245551E+08	3.116001E+12	0.00013625	0.00315779	23.17645901	3396.38750	60000.00000
4.247363E+08	3.042887E+12	0.00013958	0.00322212	23.08387452	3399.14698	60000.00000
4.248910E+08	2.972998E+12	0.00014292	0.00328743	23.00242692	3399.29031	60000.00000
4.250180E+08	2.906106E+12	0.00014625	0.00335380	22.93198639	3390.47219	60000.00000
4.251422E+08	2.842176E+12	0.00014958	0.00342034	22.86578268	3381.61069	60000.00000
4.252636E+08	2.781015E+12	0.00015292	0.00348705	22.80356795	3372.70463	60000.00000
4.253552E+08	2.722273E+12	0.00015625	0.00355321	22.74055463	3363.94114	60000.00000
4.254075E+08	2.665739E+12	0.00015958	0.00361857	22.67509049	3367.69721	60000.00000
4.254557E+08	2.611493E+12	0.00016292	0.00368415	22.61370975	3376.02769	60000.00000
4.254777E+08	2.559265E+12	0.00016625	0.00375091	22.56188840	3383.41921	60000.00000
4.254968E+08	2.509072E+12	0.00016958	0.00381787	22.51322991	3389.49075	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 424064.41017 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number           =           1
Depth below pile head       =      60.000 in
Depth below ground surface  =      48.000 in
Equivalent Depth (see note) =      48.000 in
Pile Diameter               =     132.000 in
Angle of Friction           =      46.000 deg.
Avg. Eff. Unit Weight       =     0.05300 pci
k                           =     225.000 pci
A (static)                  =      2.5755
B (static)                  =      1.9145
Pst                         =    2979.144 lbs/in
Psd                         =   82368.160 lbs/in
Ps                          =    2979.144 lbs/in
Cbar                        =   4587.6751
n                           =      3.6210
m                           =    715.9795
yk                          =      0.3064 in
pm                          =    5703.707 lbs/in
ym                          =      2.2000 in
pu                          =    7672.651 lbs/in
yu                          =      4.9500 in
p-multiplier                =     1.00000
y-multiplier                =     1.00000
```

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in	
0.0000	0.0000	
0.1833333	1980.0000	*
0.3666667	3477.4460	
0.5500000	3889.4693	
0.7333333	4211.0834	
0.9166667	4478.7502	
1.1000	4710.0313	
1.2833	4914.8701	
1.4667	5099.4965	
1.6500	5268.0968	
1.8333	5423.6329	
2.0167	5568.2847	
2.2000	5703.7075	
3.5750	6688.1793	
4.9500	7672.6512	
136.9500	7672.6512	
268.9500	7672.6512	

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number           =           3
Depth below pile head       =     180.000 in
Depth below ground surface  =     168.000 in
Equivalent Depth (see note) =     157.191 in
Pile Diameter               =     132.000 in
Angle of Friction           =      48.000 deg.
Avg. Eff. Unit Weight       =     0.06414 pci
k                           =     225.000 pci
A (static)                  =      1.9764
B (static)                  =      1.4369
Pst                         =   24163.023 lbs/in
Psd                         =  473491.298 lbs/in
Ps                          =   24163.023 lbs/in
Cbar                        =  27399.8689
n                           =      3.3296
m                           =   4740.0425
yk                          =      0.6943 in
pm                          =   34720.960 lbs/in
ym                          =      2.2000 in
pu                          =   47756.076 lbs/in
yu                          =      4.9500 in
p-multiplier                =     1.00000
y-multiplier                =     1.00000
```

This p-y curve is computed using the equivalent depth.

y, in	p, lbs/in	
0.0000	0.0000	
0.1833333	6484.1278	*
0.3666667	12968.2557	*
0.5500000	19452.3835	*
0.7333333	24962.7894	
0.9166667	26693.1033	
1.1000	28195.5366	
1.2833	29531.6127	
1.4667	30740.0427	
1.6500	31846.9331	
1.8333	32870.8112	
2.0167	33825.3502	
2.2000	34720.9595	
3.5750	41238.5180	
4.9500	47756.0764	
136.9500	47756.0764	
268.9500	47756.0764	

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 221503.000 lbs
Specified moment at pile head = 235128000.000 in-lbs
Specified axial load at pile head = 117367.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	1.609	2.35E+08	2.22E+05	-0.008843	1049.893	1.35E+13	0.000	0.000
3.360	1.580	2.36E+08	2.22E+05	-0.008785	1053.204	1.35E+13	0.000	0.000
6.720	1.550	2.37E+08	2.22E+05	-0.008726	1056.515	1.35E+13	0.000	0.000
10.080	1.521	2.37E+08	2.22E+05	-0.008667	1059.827	1.35E+13	0.000	0.000
13.440	1.492	2.38E+08	2.21E+05	-0.008608	1063.138	1.35E+13	-117.608	264.832
16.800	1.463	2.39E+08	2.20E+05	-0.008549	1066.443	1.35E+13	-400.012	918.497
20.160	1.435	2.40E+08	2.19E+05	-0.008489	1069.728	1.35E+13	-693.015	1623.031
23.520	1.406	2.40E+08	2.16E+05	-0.008430	1072.978	1.35E+13	-995.902	2379.529
26.880	1.378	2.41E+08	2.12E+05	-0.008370	1076.179	1.35E+13	-1307.955	3189.132
30.240	1.350	2.42E+08	2.07E+05	-0.008310	1079.314	1.35E+13	-1628.460	4053.022
33.600	1.322	2.42E+08	2.01E+05	-0.008250	1082.367	1.35E+13	-1956.698	4972.432
36.960	1.295	2.43E+08	1.94E+05	-0.008189	1085.323	1.35E+13	-2291.953	5948.646
40.320	1.267	2.44E+08	1.86E+05	-0.008129	1088.163	1.35E+13	-2633.505	6983.002
43.680	1.240	2.44E+08	1.76E+05	-0.008068	1090.872	1.35E+13	-2980.636	8076.899
47.040	1.213	2.45E+08	1.65E+05	-0.008007	1093.432	1.35E+13	-3332.627	9231.795
50.400	1.186	2.45E+08	1.54E+05	-0.007946	1095.825	1.35E+13	-3688.758	10449.
53.760	1.160	2.46E+08	1.41E+05	-0.007885	1098.034	1.35E+13	-4048.309	11731.
57.120	1.133	2.46E+08	1.26E+05	-0.007824	1100.040	1.35E+13	-4410.556	13078.
60.480	1.107	2.47E+08	1.11E+05	-0.007763	1101.825	1.35E+13	-4774.779	14493.
63.840	1.081	2.47E+08	94391.	-0.007701	1103.372	1.35E+13	-5140.255	15977.
67.200	1.055	2.47E+08	76505.	-0.007640	1104.661	1.35E+13	-5506.258	17533.
70.560	1.030	2.48E+08	57389.	-0.007578	1105.676	1.35E+13	-5872.064	19162.
73.920	1.004	2.48E+08	36709.	-0.007517	1106.396	1.35E+13	-6437.613	21538.
77.280	0.979136	2.48E+08	14200.	-0.007455	1106.794	1.35E+13	-6960.680	23886.
80.640	0.954191	2.48E+08	-10067.	-0.007393	1106.845	1.35E+13	-7483.955	26353.
84.000	0.929454	2.48E+08	-36109.	-0.007332	1106.521	1.35E+13	-8017.002	28982.
87.360	0.904923	2.48E+08	-63940.	-0.007270	1105.796	1.35E+13	-8549.639	31745.
90.720	0.880600	2.47E+08	-93560.	-0.007208	1104.643	1.35E+13	-9080.871	34649.
94.080	0.856483	2.47E+08	-1.25E+05	-0.007147	1103.036	1.35E+13	-9609.709	37699.
97.440	0.832573	2.47E+08	-1.58E+05	-0.007085	1100.949	1.35E+13	-10135.	40902.
100.800	0.808869	2.46E+08	-1.93E+05	-0.007024	1098.355	1.35E+13	-10656.	44266.
104.160	0.785371	2.45E+08	-2.30E+05	-0.006963	1095.228	1.35E+13	-11172.	47796.
107.520	0.762078	2.45E+08	-2.68E+05	-0.006902	1091.542	1.35E+13	-11681.	51503.
110.880	0.738988	2.44E+08	-3.08E+05	-0.006841	1087.272	1.35E+13	-12183.	55395.
114.240	0.716103	2.42E+08	-3.50E+05	-0.006781	1082.393	1.35E+13	-12677.	59482.
117.600	0.693420	2.41E+08	-3.93E+05	-0.006721	1076.880	1.35E+13	-13162.	63775.

120.960	0.670938	2.40E+08	-4.38E+05	-0.006661	1070.709	1.35E+13	-13636.	68286.
124.320	0.648656	2.38E+08	-4.85E+05	-0.006602	1063.856	1.35E+13	-14098.	73028.
127.680	0.626574	2.37E+08	-5.33E+05	-0.006543	1056.298	1.35E+13	-14549.	78016.
131.040	0.604688	2.35E+08	-5.83E+05	-0.006484	1048.012	1.35E+13	-14985.	83267.
134.400	0.582999	2.33E+08	-6.33E+05	-0.006426	1038.977	1.35E+13	-14638.	84363.
137.760	0.561504	2.30E+08	-6.82E+05	-0.006369	1029.210	1.35E+13	-14523.	86903.
141.120	0.540201	2.28E+08	-7.30E+05	-0.006312	1018.717	1.35E+13	-14380.	89443.
144.480	0.519088	2.26E+08	-7.78E+05	-0.006256	1007.505	1.35E+13	-14211.	91983.
147.840	0.498164	2.23E+08	-8.26E+05	-0.006200	995.582	1.35E+13	-14014.	94523.
151.200	0.477425	2.20E+08	-8.72E+05	-0.006145	982.958	1.35E+13	-13792.	97064.
154.560	0.456869	2.17E+08	-9.18E+05	-0.006091	969.645	1.36E+13	-13543.	99604.
157.920	0.436494	2.14E+08	-9.63E+05	-0.006037	955.654	1.36E+13	-13269.	1.02E+05
161.280	0.416297	2.11E+08	-1.01E+06	-0.005985	941.000	1.36E+13	-12970.	1.05E+05
164.640	0.396276	2.07E+08	-1.05E+06	-0.005933	925.698	1.36E+13	-12646.	1.07E+05
168.000	0.376427	2.03E+08	-1.09E+06	-0.005882	909.763	1.36E+13	-12297.	1.10E+05
171.360	0.356747	2.00E+08	-1.13E+06	-0.005832	893.213	1.36E+13	-11924.	1.12E+05
174.720	0.337233	1.96E+08	-1.17E+06	-0.005783	876.067	1.36E+13	-11527.	1.15E+05
178.080	0.317882	1.92E+08	-1.21E+06	-0.005735	858.344	1.36E+13	-11106.	1.17E+05
181.440	0.298691	1.88E+08	-1.25E+06	-0.005689	840.066	1.36E+13	-10661.	1.20E+05
184.800	0.279655	1.84E+08	-1.28E+06	-0.005643	821.255	1.36E+13	-10193.	1.22E+05
188.160	0.260772	1.79E+08	-1.32E+06	-0.005598	801.934	1.36E+13	-9701.744	1.25E+05
191.520	0.242037	1.75E+08	-1.35E+06	-0.005554	782.128	1.36E+13	-9187.725	1.28E+05
194.880	0.223448	1.70E+08	-1.38E+06	-0.005512	761.863	1.36E+13	-8650.990	1.30E+05
198.240	0.204999	1.65E+08	-1.41E+06	-0.005470	741.165	1.36E+13	-8091.714	1.33E+05
201.600	0.186688	1.61E+08	-1.43E+06	-0.005430	720.062	1.36E+13	-7510.060	1.35E+05
204.960	0.168509	1.56E+08	-1.46E+06	-0.005391	698.584	1.36E+13	-6906.173	1.38E+05
208.320	0.150460	1.51E+08	-1.48E+06	-0.005353	676.761	1.36E+13	-6280.187	1.40E+05
211.680	0.132535	1.46E+08	-1.50E+06	-0.005317	654.623	1.36E+13	-5632.216	1.43E+05
215.040	0.114732	1.41E+08	-1.52E+06	-0.005281	632.204	1.37E+13	-4962.364	1.45E+05
218.400	0.097044	1.36E+08	-1.53E+06	-0.005247	609.536	1.37E+13	-4270.713	1.48E+05
221.760	0.079469	1.31E+08	-1.54E+06	-0.005215	586.655	1.37E+13	-3557.349	1.50E+05
225.120	0.062002	1.25E+08	-1.55E+06	-0.005195	563.596	5.58E+13	-2822.316	1.53E+05
228.480	0.044560	1.20E+08	-1.56E+06	-0.005188	540.396	6.01E+13	-2062.044	1.55E+05
231.840	0.027140	1.15E+08	-1.57E+06	-0.005181	517.093	6.02E+13	-1276.461	1.58E+05
235.200	0.009742	1.10E+08	-1.57E+06	-0.005175	493.726	6.02E+13	-465.569	1.61E+05
238.560	-0.007635	1.04E+08	-1.57E+06	-0.005169	470.336	6.03E+13	370.631	1.63E+05
241.920	-0.024993	9.90E+07	-1.57E+06	-0.005163	446.964	6.03E+13	1232.143	1.66E+05
245.280	-0.042332	9.37E+07	-1.56E+06	-0.005158	423.654	6.04E+13	2118.973	1.68E+05
248.640	-0.059654	8.85E+07	-1.55E+06	-0.005153	400.449	6.04E+13	3031.130	1.71E+05
252.000	-0.076959	8.33E+07	-1.54E+06	-0.005148	377.397	6.05E+13	3968.624	1.73E+05
255.360	-0.094249	7.81E+07	-1.53E+06	-0.005144	354.542	6.06E+13	4931.472	1.76E+05
258.720	-0.111524	7.30E+07	-1.51E+06	-0.005139	331.935	6.06E+13	5919.688	1.78E+05
262.080	-0.128786	6.80E+07	-1.49E+06	-0.005135	309.623	6.07E+13	6933.293	1.81E+05
265.440	-0.146034	6.30E+07	-1.46E+06	-0.005132	287.658	6.07E+13	7972.306	1.83E+05
268.800	-0.163272	5.81E+07	-1.43E+06	-0.005129	266.091	6.08E+13	9036.751	1.86E+05
272.160	-0.180498	5.34E+07	-1.40E+06	-0.005125	244.977	6.08E+13	10127.	1.89E+05
275.520	-0.197714	4.87E+07	-1.37E+06	-0.005123	224.368	6.09E+13	11242.	1.91E+05
278.880	-0.214922	4.42E+07	-1.33E+06	-0.005120	204.322	6.09E+13	12383.	1.94E+05
282.240	-0.232121	3.98E+07	-1.28E+06	-0.005118	184.895	6.09E+13	13421.	1.94E+05
285.600	-0.249313	3.56E+07	-1.24E+06	-0.005116	166.139	6.10E+13	14603.	1.97E+05
288.960	-0.266498	3.15E+07	-1.19E+06	-0.005114	148.113	6.10E+13	15811.	1.99E+05
292.320	-0.283678	2.76E+07	-1.13E+06	-0.005112	130.877	6.11E+13	17045.	2.02E+05
295.680	-0.300852	2.39E+07	-1.07E+06	-0.005111	114.494	6.11E+13	18304.	2.04E+05
299.040	-0.318022	2.04E+07	-1.01E+06	-0.005110	99.026	6.11E+13	19589.	2.07E+05
302.400	-0.335188	1.72E+07	-9.39E+05	-0.005109	84.537	6.11E+13	20900.	2.10E+05
305.760	-0.352351	1.41E+07	-8.67E+05	-0.005108	71.093	6.11E+13	22237.	2.12E+05
309.120	-0.369512	1.13E+07	-7.90E+05	-0.005107	58.761	6.11E+13	23599.	2.15E+05
312.480	-0.386670	8.81E+06	-7.08E+05	-0.005106	47.609	6.11E+13	24987.	2.17E+05
315.840	-0.403827	6.58E+06	-6.22E+05	-0.005106	37.707	6.11E+13	26401.	2.20E+05
319.200	-0.420982	4.64E+06	-5.31E+05	-0.005106	29.124	6.11E+13	27841.	2.22E+05
322.560	-0.438137	3.02E+06	-4.35E+05	-0.005105	21.934	6.11E+13	29307.	2.25E+05
325.920	-0.455291	1.72E+06	-3.34E+05	-0.005105	16.208	6.11E+13	30798.	2.27E+05
329.280	-0.472444	7.78E+05	-2.28E+05	-0.005105	12.023	6.11E+13	32316.	2.30E+05
332.640	-0.489598	1.98E+05	-1.16E+05	-0.005105	9.453	6.11E+13	33859.	2.32E+05
336.000	-0.506752	0.000	0.000	-0.005105	8.576	6.11E+13	35429.	1.17E+05

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection            =     1.60940319 in
Computed slope at pile head     =    -0.00884309
```

```
Maximum bending moment           =   2.479877E+08 lbs-in
Maximum shear force              =      -1571860. lbs
Depth of maximum bending moment  =    80.64000000 in
Depth of maximum shear force     =      238.56000 in
Number of iterations             =             41
Number of zero deflection points =              1
```

```
-----------------------------------------------------------------------------
                          Summary of Pile Response(s)
-----------------------------------------------------------------------------

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad

Load  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection   Moment      Shear
          1            2            lbs         in        in-lbs      lbs
---- ------------ ------------ ----------- ----------- ----------- -----------
  1  V=  2.22E+05 M=  2.35E+08     117367.      1.6094  2.4799E+08   -1571860.

The analysis ended normally.
```

B.16 Drained Analysis from BPT (Ultimate)

```
===============================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.47)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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                            All Rights Reserved

===============================================================================

This program is licensed to:

Zach McClellan
University Of Utah

-------------------------------------------------------------------------------
                           Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:      C:\Documents and Settings\Zach
McClellan\Desktop\School\Research\Tremonton\LPILE\
Name of input data file:     Drilled Shaft Analysis Using Becker Friction Angles.lpd
Name of output file:         Drilled Shaft Analysis Using Becker Friction Angles.lpo
Name of plot output file:    Drilled Shaft Analysis Using Becker Friction Angles.lpp
Name of runtime file:        Drilled Shaft Analysis Using Becker Friction Angles.lpr


-----------------------------------------------------------------------------
                          Time and Date of Analysis
-----------------------------------------------------------------------------

              Date:  October 11, 2012     Time:  12:35:49


-----------------------------------------------------------------------------
                                Problem Title
-----------------------------------------------------------------------------

Drilled Shaft Analysis Using Becker Friction Angles

-----------------------------------------------------------------------------
```

```
                                Program Options
------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments            =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1


------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
------------------------------------------------------------------------------

Pile Length                               =     336.00 in

Depth of ground surface below top of pile =      12.00 in

Slope angle of ground surface             =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Point         Pile      Moment of       Pile      Modulus of
 No.     Depth       Diameter     Inertia        Area      Elasticity
          in            in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------  ----------   ----------   -----------
  1       0.0000     132.00000    14902723.   13685.0000      3604997.
  2     336.0000     132.00000    14902723.   13685.0000      3604997.

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.


------------------------------------------------------------------------------
                      Soil and Rock Layering Information
------------------------------------------------------------------------------

The soil profile is modelled using  5 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       12.000 in
Distance from top of pile to bottom of layer =       72.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =       72.000 in
Distance from top of pile to bottom of layer =      132.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
```

```
the above soil layer.

Layer  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      132.000 in
Distance from top of pile to bottom of layer =      282.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      282.000 in
Distance from top of pile to bottom of layer =      396.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.

Layer  5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      396.000 in
Distance from top of pile to bottom of layer =      700.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.


(Depth of lowest layer extends  364.00 in below pile tip)


------------------------------------------------------------------------------
                   Effective Unit Weight of Soil vs. Depth
------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 10 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           12.00        0.05300
  2           72.00        0.05300
  3           72.00        0.07300
  4          132.00        0.07300
  5          132.00        0.06700
  6          282.00        0.06700
  7          282.00        0.07000
  8          396.00        0.07000
  9          396.00        0.06900
 10          700.00        0.06900



------------------------------------------------------------------------------
                           Shear Strength of Soils
------------------------------------------------------------------------------

Shear strength parameters with depth defined using 10 points

Point    Depth X     Cohesion c     Angle of Friction     E50 or      RQD
 No.       in         lbs/in**2           Deg.             k_rm        %
-----   --------     ----------     ------------------    ------     ------
  1       12.000        0.00000           46.00            ------     ------
  2       72.000        0.00000           46.00            ------     ------
  3       72.000        0.00000           47.00            ------     ------
  4      132.000        0.00000           47.00            ------     ------
  5      132.000        0.00000           48.00            ------     ------
  6      282.000        0.00000           48.00            ------     ------
  7      282.000        0.00000           48.00            ------     ------
  8      396.000        0.00000           48.00            ------     ------
  9      396.000        0.00000           48.00            ------     ------
 10      700.000        0.00000           48.00            ------     ------

Notes:

(1)  Cohesion = uniaxial compressive strength for rock materials.
(2)  Values of E50 are reported for clay strata.
(3)  Default values will be generated for E50 when input values are 0.
(4)  RQD and k_rm are reported only for weak rock strata.
```

```
--------------------------------------------------------------------------------
                          p-y Modification Factors
--------------------------------------------------------------------------------

Distribution of p-y multipliers with depth defined using  4 points

Point      Depth X         p-mult        y-mult
 No.       in
-----     ----------     ----------     ----------
  1          12.000         1.0000         1.0000
  2          42.000         1.0000         1.0000
  3          42.001         1.0000         1.0000
  4         700.000         1.0000         1.0000


--------------------------------------------------------------------------------
                                Loading Type
--------------------------------------------------------------------------------

Static loading criteria was used for computation of p-y curves.


--------------------------------------------------------------------------------
              Pile-head Loading and Pile-head Fixity Conditions
--------------------------------------------------------------------------------

Number of loads specified =  1

Load Case Number  1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head    =      319693.000 lbs
Bending moment at pile head =   345051000.000 in-lbs
Axial load at pile head     =      189766.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head
may rotate under the applied pile-head loading, but is not a free-head
(zero moment) condition.



--------------------------------------------------------------------------------
                   Output of p-y Curves at Specified Depths
--------------------------------------------------------------------------------


p-y curves are generated and printed for verification at  2 depths.

Depth      Depth Below Pile Head      Depth Below Ground Surface
 No.                in                            in
-----      ---------------------      --------------------------
  1               60.000                        48.000
  2              180.000                       168.000

Depth of ground surface below top of pile =      12.00 in


--------------------------------------------------------------------------------
   Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

Number of sections =  1


Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter                       =     132.0000 in

Material Properties:
```

Compressive Strength of Concrete	=	4.000 kip/in**2
Yield Stress of Reinforcement	=	60. kip/in**2
Modulus of Elasticity of Reinforcement	=	29000. kip/in**2
Number of Reinforcing Bars	=	100
Area of Single Bar	=	1.27000 in**2
Number of Rows of Reinforcing Bars	=	51
Area of Steel	=	127.000 in**2
Area of Shaft	=	13684.778 in**2
Percentage of Steel Reinforcement	=	0.928 percent
Cover Thickness (edge to bar center)	=	4.000 in

Unfactored Axial Squash Load Capacity = 53716.45 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.270	62.000
2	2.540	61.878
3	2.540	61.511
4	2.540	60.902
5	2.540	60.052
6	2.540	58.966
7	2.540	57.646
8	2.540	56.099
9	2.540	54.331
10	2.540	52.348
11	2.540	50.159
12	2.540	47.772
13	2.540	45.196
14	2.540	42.442
15	2.540	39.520
16	2.540	36.443
17	2.540	33.221
18	2.540	29.869
19	2.540	26.398
20	2.540	22.824
21	2.540	19.159
22	2.540	15.419
23	2.540	11.618
24	2.540	7.771
25	2.540	3.893
26	2.540	0.000
27	2.540	-3.893
28	2.540	-7.771
29	2.540	-11.618
30	2.540	-15.419
31	2.540	-19.159
32	2.540	-22.824
33	2.540	-26.398
34	2.540	-29.869
35	2.540	-33.221
36	2.540	-36.443
37	2.540	-39.520
38	2.540	-42.442
39	2.540	-45.196
40	2.540	-47.772
41	2.540	-50.159
42	2.540	-52.348
43	2.540	-54.331
44	2.540	-56.099
45	2.540	-57.646
46	2.540	-58.966
47	2.540	-60.052
48	2.540	-60.902
49	2.540	-61.511
50	2.540	-61.878
51	1.270	-62.000

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
25476354.	6.114325E+13	4.166667E-07	0.00002759	66.21587902	97.95153255	751.77520
50726322.	6.087159E+13	8.333333E-07	0.00005518	66.21542269	194.47007	1503.53938

75749906.	6.059992E+13	0.00000125	0.00008277	66.21496242	289.55565	2255.29239
1.005471E+08	6.032826E+13	0.00000167	0.00011036	66.21449822	383.20832	3007.03408
1.251179E+08	6.005660E+13	0.00000208	0.00013795	66.21403009	475.42813	3758.76432
1.251179E+08	5.004717E+13	0.00000250	0.00008208	32.83139080	282.36798	6899.72417
1.251179E+08	4.289757E+13	0.00000292	0.00009582	32.85245293	328.45176	8047.89669
1.251179E+08	3.753538E+13	0.00000333	0.00010958	32.87361342	374.25373	9195.55070
1.251179E+08	3.336478E+13	0.00000375	0.00012336	32.89486831	419.77288	10342.68307
1.251179E+08	3.002830E+13	0.00000417	0.00013715	32.91622549	465.00833	11489.28942
1.251179E+08	2.729846E+13	0.00000458	0.00015096	32.93768102	509.95903	12635.36656
1.251179E+08	2.502358E+13	0.00000500	0.00016480	32.95923489	554.62396	13780.91094
1.251179E+08	2.309869E+13	0.00000542	0.00017865	32.98088712	599.00210	14925.91898
1.251179E+08	2.144879E+13	0.00000583	0.00019250	33.00000197	643.04206	16070.83300
1.251179E+08	2.001887E+13	0.00000625	0.00020625	33.00000197	686.39668	17218.74964
1.251179E+08	1.876769E+13	0.00000667	0.00022000	33.00000197	729.40771	18366.66629
1.251179E+08	1.766371E+13	0.00000708	0.00023375	33.00000197	772.07514	19514.58293
1.251179E+08	1.668239E+13	0.00000750	0.00024755	33.00632769	814.54943	20661.12373
1.251179E+08	1.580437E+13	0.00000792	0.00026146	33.02685088	857.04776	21804.25215
1.251179E+08	1.501415E+13	0.00000833	0.00027540	33.04746455	899.24960	22946.86273
1.251179E+08	1.429919E+13	0.00000875	0.00028935	33.06817263	941.15399	24088.95119
1.253194E+08	1.367120E+13	0.00000917	0.00030332	33.08897513	982.75989	25230.51411
1.309487E+08	1.366421E+13	0.00000958	0.00031730	33.10987204	1024.06623	26371.54806
1.365720E+08	1.365720E+13	0.00001000	0.00033131	33.13086337	1065.07192	27512.04962
1.421891E+08	1.365015E+13	0.00001042	0.00034533	33.15195304	1105.77599	28652.01419
1.478001E+08	1.364308E+13	0.00001083	0.00035938	33.17314106	1146.17733	29791.43818
1.534049E+08	1.363599E+13	0.00001125	0.00037344	33.19442743	1186.27483	30930.31805
1.590035E+08	1.362887E+13	0.00001167	0.00038752	33.21581608	1226.06748	32068.64889
1.645958E+08	1.362172E+13	0.00001208	0.00040162	33.23730308	1265.55403	33206.42838
1.701818E+08	1.361454E+13	0.00001250	0.00041574	33.25889236	1304.73343	34343.65152
1.757615E+08	1.360734E+13	0.00001292	0.00042987	33.28058392	1343.60454	35480.31461
1.813348E+08	1.360011E+13	0.00001333	0.00044403	33.30237776	1382.16615	36616.41393
1.869017E+08	1.359285E+13	0.00001375	0.00045821	33.32427782	1420.41723	37751.94422
1.924622E+08	1.358556E+13	0.00001417	0.00047241	33.34628409	1458.35657	38886.90162
1.980161E+08	1.357825E+13	0.00001458	0.00048662	33.36839265	1495.98280	40021.28394
2.035636E+08	1.357091E+13	0.00001500	0.00050086	33.39061528	1533.29513	41155.08235
2.091045E+08	1.356353E+13	0.00001542	0.00051512	33.41294414	1570.29200	42288.29622
2.146388E+08	1.355613E+13	0.00001583	0.00052939	33.43538314	1606.97232	43420.91991
2.201664E+08	1.354870E+13	0.00001625	0.00054369	33.45793229	1643.33480	44552.94941
2.312016E+08	1.353375E+13	0.00001708	0.00057235	33.50336891	1715.10137	46815.20598
2.422097E+08	1.351868E+13	0.00001792	0.00060109	33.54926187	1785.58150	49075.02935
2.531904E+08	1.350349E+13	0.00001875	0.00062992	33.59562689	1854.76509	51332.37788
2.641432E+08	1.348817E+13	0.00001958	0.00065883	33.64246398	1922.64107	53587.21733
2.750680E+08	1.347272E+13	0.00002042	0.00068783	33.68978888	1989.19882	55839.50417
2.859642E+08	1.345714E+13	0.00002125	0.00071692	33.73761338	2054.42728	58089.19575
2.967232E+08	1.343652E+13	0.00002208	0.00074601	33.78144497	2118.09301	60000.00000
3.052926E+08	1.332186E+13	0.00002292	0.00077317	33.73828608	2176.02906	60000.00000
3.124730E+08	1.315676E+13	0.00002375	0.00079909	33.64578027	2229.97326	60000.00000
3.187410E+08	1.296574E+13	0.00002458	0.00082417	33.52554435	2280.95855	60000.00000
3.243247E+08	1.276031E+13	0.00002542	0.00084861	33.38796383	2329.50000	60000.00000
3.293689E+08	1.254739E+13	0.00002625	0.00087253	33.23941952	2375.93339	60000.00000
3.339510E+08	1.233050E+13	0.00002708	0.00089600	33.08319622	2420.44829	60000.00000
3.390265E+08	1.214423E+13	0.00002792	0.00092125	33.00000197	2467.36427	60000.00000
3.421665E+08	1.190144E+13	0.00002875	0.00094422	32.84229559	2508.88759	60000.00000
3.457708E+08	1.168803E+13	0.00002958	0.00096634	32.66486853	2547.92546	60000.00000
3.490333E+08	1.147507E+13	0.00003042	0.00098803	32.48322433	2585.33441	60000.00000
3.521400E+08	1.126848E+13	0.00003125	0.00100955	32.30569893	2621.60086	60000.00000
3.550246E+08	1.106570E+13	0.00003208	0.00103080	32.12880296	2656.57286	60000.00000
3.577186E+08	1.086740E+13	0.00003292	0.00105180	31.95342547	2690.33435	60000.00000
3.602788E+08	1.067493E+13	0.00003375	0.00107264	31.78199762	2723.05334	60000.00000
3.626651E+08	1.048670E+13	0.00003458	0.00109325	31.61198598	2754.62514	60000.00000
3.649275E+08	1.030384E+13	0.00003542	0.00111370	31.44555420	2785.20094	60000.00000
3.671024E+08	1.012696E+13	0.00003625	0.00113404	31.28386277	2814.87554	60000.00000
3.690935E+08	9.953084E+12	0.00003708	0.00115411	31.12201399	2843.41113	60000.00000
3.710781E+08	9.786676E+12	0.00003792	0.00117421	30.96817070	2871.28187	60000.00000
3.728888E+08	9.622938E+12	0.00003875	0.00119403	30.81374913	2898.04725	60000.00000
3.748703E+08	9.470408E+12	0.00003958	0.00121808	30.77244705	2929.84195	60000.00000
3.765709E+08	9.317218E+12	0.00004042	0.00123730	30.61348969	2954.26711	60000.00000
3.781214E+08	9.166580E+12	0.00004125	0.00125623	30.45398551	2977.67239	60000.00000
3.795985E+08	9.020163E+12	0.00004208	0.00127504	30.29793924	3000.29647	60000.00000
3.810705E+08	8.879312E+12	0.00004292	0.00129388	30.14866322	3022.33472	60000.00000
3.824793E+08	8.742383E+12	0.00004375	0.00131261	30.00261301	3043.62131	60000.00000
3.837522E+08	8.607525E+12	0.00004458	0.00133107	29.85567766	3063.96715	60000.00000
3.850203E+08	8.477511E+12	0.00004542	0.00134955	29.71478087	3083.74758	60000.00000
3.862836E+08	8.352078E+12	0.00004625	0.00136806	29.57960004	3102.95979	60000.00000
3.874732E+08	8.229519E+12	0.00004708	0.00138642	29.44603604	3121.41473	60000.00000
3.885611E+08	8.109101E+12	0.00004792	0.00140456	29.31245631	3139.05286	60000.00000
3.896445E+08	7.992708E+12	0.00004875	0.00142272	29.18403000	3156.14208	60000.00000
3.907234E+08	7.880136E+12	0.00004958	0.00144092	29.06049746	3172.67950	60000.00000
3.927391E+08	7.663203E+12	0.00005125	0.00147703	28.82004136	3203.76888	60000.00000
3.928849E+08	7.424596E+12	0.00005292	0.00151342	28.59999830	3232.79798	60000.00000
3.966872E+08	7.267552E+12	0.00005458	0.00155510	28.49045867	3263.39404	60000.00000
3.982476E+08	7.079958E+12	0.00005625	0.00158917	28.25193018	3285.88009	60000.00000

3.997207E+08	6.901653E+12	0.00005792	0.00162309	28.02449924	3306.25345	60000.00000
4.011796E+08	6.733083E+12	0.00005958	0.00165711	27.81155688	3324.68210	60000.00000
4.024870E+08	6.571216E+12	0.00006125	0.00169069	27.60316998	3340.88958	60000.00000
4.037013E+08	6.416444E+12	0.00006292	0.00172407	27.40249747	3355.04838	60000.00000
4.049021E+08	6.269452E+12	0.00006458	0.00175756	27.21378404	3367.30862	60000.00000
4.060892E+08	6.129649E+12	0.00006625	0.00179114	27.03614062	3377.65146	60000.00000
4.070893E+08	5.993952E+12	0.00006792	0.00182407	26.85745865	3385.87838	60000.00000
4.080697E+08	5.864474E+12	0.00006958	0.00185707	26.68836755	3392.23773	60000.00000
4.090370E+08	5.740870E+12	0.00007125	0.00189016	26.52863127	3396.71998	60000.00000
4.104244E+08	5.628678E+12	0.00007292	0.00192500	26.40000039	3399.38858	60000.00000
4.112162E+08	5.513513E+12	0.00007458	0.00196794	26.38583833	3395.76365	60000.00000
4.119213E+08	5.402246E+12	0.00007625	0.00199909	26.21758908	3388.01797	60000.00000
4.126212E+08	5.295674E+12	0.00007792	0.00203034	26.05779773	3390.91516	60000.00000
4.133160E+08	5.193500E+12	0.00007958	0.00206168	25.90594894	3395.12405	60000.00000
4.140054E+08	5.095451E+12	0.00008125	0.00209313	25.76156670	3398.04262	60000.00000
4.146886E+08	5.001270E+12	0.00008292	0.00212467	25.62415141	3399.65551	60000.00000
4.152413E+08	4.909256E+12	0.00008458	0.00215552	25.48392731	3398.27690	60000.00000
4.157833E+08	4.820676E+12	0.00008625	0.00218654	25.35120910	3391.53208	60000.00000
4.163220E+08	4.735417E+12	0.00008792	0.00221764	25.22439176	3384.76707	60000.00000
4.168576E+08	4.653294E+12	0.00008958	0.00224882	25.10315663	3387.41726	60000.00000
4.173898E+08	4.574134E+12	0.00009125	0.00228008	24.98720866	3391.83006	60000.00000
4.179185E+08	4.497778E+12	0.00009292	0.00231142	24.87626857	3395.30434	60000.00000
4.184053E+08	4.423668E+12	0.00009458	0.00234253	24.76681942	3397.80157	60000.00000
4.188306E+08	4.351486E+12	0.00009625	0.00237325	24.65711850	3399.34294	60000.00000
4.192528E+08	4.281731E+12	0.00009792	0.00240404	24.55194157	3399.98156	60000.00000
4.196653E+08	4.214212E+12	0.00009958	0.00243503	24.45221704	3395.38769	60000.00000
4.200742E+08	4.148881E+12	0.00010125	0.00246611	24.35663098	3389.59867	60000.00000
4.204675E+08	4.085515E+12	0.00010292	0.00249746	24.26678056	3383.73787	60000.00000
4.204675E+08	4.020407E+12	0.00010458	0.00253092	24.19999856	3379.76754	60000.00000
4.204675E+08	3.957342E+12	0.00010625	0.00257125	24.19999856	3386.74680	60000.00000
4.208985E+08	3.900217E+12	0.00010792	0.00261158	24.19999856	3392.25526	60000.00000
4.220991E+08	3.851855E+12	0.00010958	0.00264902	24.17356664	3395.93695	60000.00000
4.223088E+08	3.796034E+12	0.00011125	0.00267986	24.08860606	3397.88513	60000.00000
4.225165E+08	3.741844E+12	0.00011292	0.00271076	24.00675720	3399.20670	60000.00000
4.227224E+08	3.689214E+12	0.00011458	0.00274174	23.92789811	3399.89447	60000.00000
4.229109E+08	3.637944E+12	0.00011625	0.00277318	23.85535294	3397.83583	60000.00000
4.232583E+08	3.539442E+12	0.00011958	0.00283693	23.72342151	3387.77541	60000.00000
4.236011E+08	3.446246E+12	0.00012292	0.00290087	23.60030991	3377.66094	60000.00000
4.239317E+08	3.357875E+12	0.00012625	0.00296524	23.48701340	3376.78559	60000.00000
4.241783E+08	3.273401E+12	0.00012958	0.00302982	23.38123852	3385.30625	60000.00000
4.243690E+08	3.192745E+12	0.00013292	0.00309369	23.27543217	3391.76040	60000.00000
4.245551E+08	3.116001E+12	0.00013625	0.00315779	23.17645901	3396.38750	60000.00000
4.247363E+08	3.042887E+12	0.00013958	0.00322212	23.08387452	3399.14698	60000.00000
4.248910E+08	2.972998E+12	0.00014292	0.00328743	23.00242692	3399.29031	60000.00000
4.250180E+08	2.906106E+12	0.00014625	0.00335380	22.93198639	3390.47219	60000.00000
4.251422E+08	2.842176E+12	0.00014958	0.00342034	22.86578268	3381.61069	60000.00000
4.252636E+08	2.781015E+12	0.00015292	0.00348705	22.80356795	3372.70463	60000.00000
4.253552E+08	2.722273E+12	0.00015625	0.00355321	22.74055463	3363.94114	60000.00000
4.254075E+08	2.665739E+12	0.00015958	0.00361857	22.67509049	3367.69721	60000.00000
4.254557E+08	2.611493E+12	0.00016292	0.00368415	22.61370975	3376.02769	60000.00000
4.254777E+08	2.559265E+12	0.00016625	0.00375091	22.56188840	3383.41921	60000.00000
4.254968E+08	2.509072E+12	0.00016958	0.00381787	22.51322991	3389.49075	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 424064.41017 in-kip

p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

```
Soil Layer Number            =           1
Depth below pile head        =      60.000 in
Depth below ground surface   =      48.000 in
Equivalent Depth (see note)  =      48.000 in
Pile Diameter                =     132.000 in
Angle of Friction            =      46.000 deg.
Avg. Eff. Unit Weight        =     0.05300 pci
k                            =     225.000 pci
A (static)                   =      2.5755
B (static)                   =      1.9145
Pst                          =    2979.144 lbs/in
Psd                          =   82368.160 lbs/in
Ps                           =    2979.144 lbs/in
Cbar                         =   4587.6751
n                            =      3.6210
m                            =    715.9795
yk                           =      0.3064 in
pm                           =    5703.707 lbs/in
ym                           =      2.2000 in
pu                           =    7672.651 lbs/in
yu                           =      4.9500 in
```

```
p-multiplier                =      1.00000
y-multiplier                =      1.00000

This p-y curve is computed using the equivalent depth.

        y, in             p, lbs/in
----------------    -----------------
         0.0000            0.0000
      0.1833333         1980.0000   *
      0.3666667         3477.4460
      0.5500000         3889.4693
      0.7333333         4211.0834
      0.9166667         4478.7502
         1.1000         4710.0313
         1.2833         4914.8701
         1.4667         5099.4965
         1.6500         5268.0968
         1.8333         5423.6329
         2.0167         5568.2847
         2.2000         5703.7075
         3.5750         6688.1793
         4.9500         7672.6512
       136.9500         7672.6512
       268.9500         7672.6512

* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.




p-y Curve in Sand Computed Using Reese Criteria for Static Loading Conditions

Soil Layer Number           =            3
Depth below pile head       =      180.000 in
Depth below ground surface  =      168.000 in
Equivalent Depth (see note) =      157.191 in
Pile Diameter               =      132.000 in
Angle of Friction           =       48.000 deg.
Avg. Eff. Unit Weight       =      0.06414 pci
k                           =      225.000 pci
A (static)                  =       1.9764
B (static)                  =       1.4369
Pst                         =    24163.023 lbs/in
Psd                         =   473491.298 lbs/in
Ps                          =    24163.023 lbs/in
Cbar                        =   27399.8689
n                           =       3.3296
m                           =    4740.0425
yk                          =       0.6943 in
pm                          =    34720.960 lbs/in
ym                          =       2.2000 in
pu                          =    47756.076 lbs/in
yu                          =       4.9500 in
p-multiplier                =      1.00000
y-multiplier                =      1.00000

This p-y curve is computed using the equivalent depth.

        y, in             p, lbs/in
----------------    -----------------
         0.0000            0.0000
      0.1833333         6484.1278   *
      0.3666667        12968.2557   *
      0.5500000        19452.3835   *
      0.7333333        24962.7894
      0.9166667        26693.1033
         1.1000        28195.5366
         1.2833        29531.6127
         1.4667        30740.0427
         1.6500        31846.9331
         1.8333        32870.8112
         2.0167        33825.3502
         2.2000        34720.9595
         3.5750        41238.5180
         4.9500        47756.0764
       136.9500        47756.0764
       268.9500        47756.0764
```

```
* p value(s) computed using p = k * Eff x * y

The above p-y curve was computed using the internal default value of k.
```

```
-------------------------------------------------------------------------------
             Computed Values of Load Distribution and Deflection
                 for Lateral Loading for Load Case Number  1
-------------------------------------------------------------------------------

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head  =      319693.000 lbs
Specified moment at pile head       =   345051000.000 in-lbs
Specified axial load at pile head   =      189766.000 lbs
```

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	3.036	3.45E+08	3.20E+05	-0.016270	1542.001	1.17E+13	0.000	0.000
3.360	2.981	3.46E+08	3.20E+05	-0.016170	1546.804	1.17E+13	0.000	0.000
6.720	2.927	3.47E+08	3.20E+05	-0.016070	1551.607	1.17E+13	0.000	0.000
10.080	2.873	3.48E+08	3.20E+05	-0.015969	1556.409	1.15E+13	0.000	0.000
13.440	2.820	3.49E+08	3.19E+05	-0.015867	1561.212	1.15E+13	-139.488	166.209
16.800	2.767	3.50E+08	3.18E+05	-0.015764	1566.006	1.14E+13	-474.409	576.146
20.160	2.714	3.52E+08	3.16E+05	-0.015660	1570.777	1.13E+13	-821.933	1017.615
23.520	2.661	3.53E+08	3.13E+05	-0.015555	1575.507	1.12E+13	-1181.296	1491.353
26.880	2.609	3.54E+08	3.08E+05	-0.015449	1580.177	1.12E+13	-1551.744	1998.139
30.240	2.558	3.55E+08	3.02E+05	-0.015342	1584.769	1.11E+13	-1932.530	2538.801
33.600	2.506	3.56E+08	2.95E+05	-0.015234	1589.264	1.10E+13	-2322.921	3114.213
36.960	2.455	3.57E+08	2.87E+05	-0.015125	1593.643	1.09E+13	-2722.188	3725.304
40.320	2.405	3.58E+08	2.77E+05	-0.015015	1597.886	1.09E+13	-3129.617	4373.059
43.680	2.354	3.59E+08	2.66E+05	-0.014904	1601.971	1.08E+13	-3544.499	5058.523
47.040	2.304	3.59E+08	2.53E+05	-0.014792	1605.879	1.07E+13	-3966.138	5782.808
50.400	2.255	3.60E+08	2.39E+05	-0.014679	1609.589	1.07E+13	-4393.844	6547.093
53.760	2.206	3.61E+08	2.24E+05	-0.014565	1613.078	1.06E+13	-4826.940	7352.634
57.120	2.157	3.62E+08	2.07E+05	-0.014451	1616.326	1.06E+13	-5264.552	8200.454
60.480	2.109	3.63E+08	1.88E+05	-0.014335	1619.311	1.05E+13	-5705.611	9091.305
63.840	2.061	3.63E+08	1.68E+05	-0.014219	1622.009	1.04E+13	-6149.300	10026.
67.200	2.013	3.64E+08	1.47E+05	-0.014102	1624.400	1.04E+13	-6594.801	11007.
70.560	1.966	3.64E+08	1.24E+05	-0.013984	1626.461	1.04E+13	-7041.295	12034.
73.920	1.919	3.65E+08	99194.	-0.013866	1628.169	1.03E+13	-7723.310	13522.
77.280	1.873	3.65E+08	72172.	-0.013747	1629.491	1.03E+13	-8361.194	15001.
80.640	1.827	3.65E+08	43004.	-0.013628	1630.395	1.03E+13	-9000.873	16555.
84.000	1.781	3.65E+08	11674.	-0.013509	1630.848	1.03E+13	-9647.928	18199.
87.360	1.736	3.65E+08	-21831.	-0.013390	1630.819	1.03E+13	-10296.	19927.
90.720	1.691	3.65E+08	-57511.	-0.013270	1630.274	1.03E+13	-10942.	21740.
94.080	1.647	3.65E+08	-95362.	-0.013152	1629.182	1.03E+13	-11588.	23642.
97.440	1.603	3.64E+08	-1.35E+05	-0.013033	1627.510	1.03E+13	-12230.	25637.
100.800	1.559	3.64E+08	-1.78E+05	-0.012915	1625.227	1.04E+13	-12868.	27730.
104.160	1.516	3.63E+08	-2.22E+05	-0.012798	1622.299	1.04E+13	-13502.	29923.
107.520	1.473	3.62E+08	-2.68E+05	-0.012681	1618.697	1.05E+13	-14129.	32223.
110.880	1.431	3.61E+08	-3.17E+05	-0.012566	1614.387	1.06E+13	-14748.	34633.
114.240	1.389	3.60E+08	-3.67E+05	-0.012452	1609.340	1.07E+13	-15359.	37159.
117.600	1.347	3.59E+08	-4.20E+05	-0.012339	1603.525	1.08E+13	-15961.	39808.
120.960	1.306	3.57E+08	-4.75E+05	-0.012228	1596.911	1.09E+13	-16551.	42586.
124.320	1.265	3.56E+08	-5.31E+05	-0.012119	1589.469	1.10E+13	-17130.	45500.
127.680	1.224	3.54E+08	-5.90E+05	-0.012011	1581.171	1.11E+13	-17695.	48557.
131.040	1.184	3.52E+08	-6.50E+05	-0.011906	1571.987	1.13E+13	-18246.	51768.
134.400	1.144	3.50E+08	-7.12E+05	-0.011802	1561.891	1.14E+13	-18536.	54419.
137.760	1.105	3.47E+08	-7.75E+05	-0.011700	1550.868	1.16E+13	-19062.	57964.
141.120	1.066	3.44E+08	-8.40E+05	-0.011601	1538.892	1.18E+13	-19572.	61699.
144.480	1.027	3.41E+08	-9.07E+05	-0.011504	1525.937	1.20E+13	-20063.	65637.
147.840	0.988523	3.38E+08	-9.75E+05	-0.011409	1511.978	1.22E+13	-20534.	69795.
151.200	0.950345	3.35E+08	-1.04E+06	-0.011317	1496.992	1.23E+13	-20984.	74191.
154.560	0.912475	3.31E+08	-1.12E+06	-0.011226	1480.957	1.25E+13	-21412.	78844.
157.920	0.874905	3.27E+08	-1.19E+06	-0.011138	1463.852	1.26E+13	-21832.	83843.
161.280	0.837628	3.23E+08	-1.26E+06	-0.011052	1445.654	1.28E+13	-22229.	89167.
164.640	0.800636	3.19E+08	-1.34E+06	-0.010968	1426.345	1.30E+13	-22600.	94843.
168.000	0.763922	3.14E+08	-1.41E+06	-0.010887	1405.905	1.31E+13	-22942.	1.01E+05
171.360	0.727479	3.09E+08	-1.49E+06	-0.010807	1384.319	1.32E+13	-23255.	1.07E+05
174.720	0.691300	3.04E+08	-1.57E+06	-0.010729	1361.569	1.33E+13	-23536.	1.14E+05
178.080	0.655378	2.99E+08	-1.65E+06	-0.010653	1337.642	1.34E+13	-22896.	1.17E+05
181.440	0.619709	2.93E+08	-1.72E+06	-0.010579	1312.571	1.34E+13	-22119.	1.20E+05
184.800	0.584285	2.87E+08	-1.80E+06	-0.010507	1286.393	1.35E+13	-21296.	1.22E+05
188.160	0.549103	2.81E+08	-1.87E+06	-0.010436	1259.150	1.35E+13	-20429.	1.25E+05
191.520	0.514156	2.75E+08	-1.93E+06	-0.010366	1230.886	1.35E+13	-19517.	1.28E+05

194.880	0.479440	2.68E+08	-2.00E+06	-0.010299	1201.645	1.35E+13	-18562.	1.30E+05
198.240	0.444948	2.61E+08	-2.06E+06	-0.010233	1171.477	1.35E+13	-17563.	1.33E+05
201.600	0.410675	2.54E+08	-2.12E+06	-0.010169	1140.430	1.35E+13	-16521.	1.35E+05
204.960	0.376615	2.47E+08	-2.17E+06	-0.010106	1108.557	1.35E+13	-15435.	1.38E+05
208.320	0.342761	2.40E+08	-2.22E+06	-0.010046	1075.912	1.35E+13	-14307.	1.40E+05
211.680	0.309108	2.32E+08	-2.27E+06	-0.009987	1042.551	1.35E+13	-13136.	1.43E+05
215.040	0.275648	2.25E+08	-2.31E+06	-0.009930	1008.534	1.35E+13	-11922.	1.45E+05
218.400	0.242376	2.17E+08	-2.35E+06	-0.009876	973.920	1.36E+13	-10666.	1.48E+05
221.760	0.209284	2.09E+08	-2.38E+06	-0.009823	938.773	1.36E+13	-9368.364	1.50E+05
225.120	0.176365	2.01E+08	-2.41E+06	-0.009772	903.157	1.36E+13	-8028.150	1.53E+05
228.480	0.143614	1.93E+08	-2.43E+06	-0.009724	867.140	1.36E+13	-6645.893	1.55E+05
231.840	0.111023	1.84E+08	-2.45E+06	-0.009677	830.790	1.36E+13	-5221.646	1.58E+05
235.200	0.078585	1.76E+08	-2.47E+06	-0.009632	794.179	1.36E+13	-3755.441	1.61E+05
238.560	0.046294	1.68E+08	-2.48E+06	-0.009590	757.380	1.36E+13	-2247.286	1.63E+05
241.920	0.014141	1.60E+08	-2.48E+06	-0.009550	720.469	1.36E+13	-697.169	1.66E+05
245.280	-0.017879	1.51E+08	-2.48E+06	-0.009511	683.523	1.36E+13	894.947	1.68E+05
248.640	-0.049774	1.43E+08	-2.48E+06	-0.009475	646.621	1.36E+13	2529.118	1.71E+05
252.000	-0.081551	1.35E+08	-2.47E+06	-0.009441	609.846	1.37E+13	4205.421	1.73E+05
255.360	-0.113217	1.26E+08	-2.45E+06	-0.009420	573.281	4.73E+13	5923.950	1.76E+05
258.720	-0.144852	1.18E+08	-2.43E+06	-0.009412	537.012	6.01E+13	7688.758	1.78E+05
262.080	-0.176466	1.10E+08	-2.40E+06	-0.009406	501.128	6.02E+13	9500.205	1.81E+05
265.440	-0.208059	1.02E+08	-2.36E+06	-0.009400	465.718	6.03E+13	11358.	1.83E+05
268.800	-0.239632	9.42E+07	-2.32E+06	-0.009394	430.877	6.04E+13	13263.	1.86E+05
272.160	-0.271188	8.64E+07	-2.27E+06	-0.009389	396.698	6.05E+13	15215.	1.89E+05
275.520	-0.302728	7.89E+07	-2.22E+06	-0.009385	363.280	6.06E+13	17213.	1.91E+05
278.880	-0.334253	7.15E+07	-2.16E+06	-0.009381	330.723	6.06E+13	19258.	1.94E+05
282.240	-0.365765	6.44E+07	-2.09E+06	-0.009377	299.129	6.07E+13	21148.	1.94E+05
285.600	-0.397265	5.75E+07	-2.01E+06	-0.009373	268.592	6.08E+13	23269.	1.97E+05
288.960	-0.428754	5.09E+07	-1.93E+06	-0.009370	239.218	6.09E+13	25438.	1.99E+05
292.320	-0.460234	4.45E+07	-1.84E+06	-0.009368	211.117	6.09E+13	27653.	2.02E+05
295.680	-0.491706	3.85E+07	-1.75E+06	-0.009365	184.398	6.10E+13	29916.	2.04E+05
299.040	-0.523170	3.28E+07	-1.64E+06	-0.009364	159.174	6.10E+13	32226.	2.07E+05
302.400	-0.554629	2.75E+07	-1.53E+06	-0.009362	135.562	6.11E+13	34583.	2.10E+05
305.760	-0.586082	2.25E+07	-1.41E+06	-0.009360	113.679	6.11E+13	36987.	2.12E+05
309.120	-0.617531	1.80E+07	-1.28E+06	-0.009359	93.646	6.11E+13	39439.	2.15E+05
312.480	-0.648977	1.39E+07	-1.15E+06	-0.009358	75.584	6.11E+13	41938.	2.17E+05
315.840	-0.680420	1.03E+07	-1.00E+06	-0.009358	59.619	6.11E+13	44484.	2.20E+05
319.200	-0.711861	7.23E+06	-8.46E+05	-0.009357	45.878	6.11E+13	47078.	2.22E+05
322.560	-0.743301	4.66E+06	-6.85E+05	-0.009357	34.491	6.11E+13	48705.	2.20E+05
325.920	-0.774740	2.64E+06	-5.20E+05	-0.009357	25.539	6.11E+13	49856.	2.16E+05
329.280	-0.806179	1.18E+06	-3.50E+05	-0.009357	19.080	6.11E+13	50992.	2.13E+05
332.640	-0.837617	2.94E+05	-1.77E+05	-0.009357	15.171	6.11E+13	52113.	2.09E+05
336.000	-0.869056	0.000	0.000	-0.009357	13.867	6.11E+13	53219.	1.03E+05

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection            =     3.03580462 in
Computed slope at pile head     =    -0.01626968
Maximum bending moment          =   3.651125E+08 lbs-in
Maximum shear force             =      -2483498. lbs
Depth of maximum bending moment =    84.00000000 in
Depth of maximum shear force    =      241.92000 in
Number of iterations            =             32
Number of zero deflection points =             1
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 3.20E+05	M= 3.45E+08	189766.	3.0358	3.6511E+08	-2483498.

The analysis ended normally.

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